THE STUDY OF MORPHOLOGICAL VARIATION AMONG THE DIGENETIC PARASITES OF FRESH-WATER FISHES OF BUNDELKHAND REGION

THESIS

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Supervisor

Dr. L.N. Agarwal
M.Sc., Ph.D.
Principal
B.N. College, Rath
(Hamirpur)

Submitted by

(Smt.) Abha Raj Singh
Deptt. of Zoology,
Bipin Behari College,
Jhansi

DR. L.N. AGARWAL
M.Sc., Ph.D.
PRINCIPAL
B.N.COLLEGE,
RATH, HAMIRPUR (U.P.)

Dated : December 22 ,2002

Certified that the thesis entitled **"The study of morphological variation among the digenetic parasites of fresh-water fishes of Bundelkhand Region"**, submitted by (Smt.) Abha Raj Singh for the degree of **Doctor of Philosophy (Ph.D)** in **Zoology** of **Bundelkhand University, Jhansi** embodies the original work done by her. She has worked under my guidance and supervision for more than twenty four months, commencing from the date of her registration.

It is further certified that the candidate has put in an attendance of over 200 days in the Department from the date of her registration for Ph.D. degree of the University as required under the relevant ordinances.

(L.N. Agarwal)
Supervisor

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Jhansi

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Abha Raj Singh

(Smt. Abha Raj Singh)

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PART - I

GENERAL

INTRODUCTION

Fishes occupy an important place in human diet, economy and ecosystem. Like other vertebrates, fishes too harbour parasitic population of diverse group of helminth parasites, which have detrimental effect on the fishes in many ways like stunted growth, postponement of sexual maturity, damage to various organs thus affecting the yield of fish production. The study of fish pathology is of much importance both from the point of view of fishery management and also to check the spread of human and animal diseases for which fishes act as carriers. The success of implementation of a various fishery development programmes depends to a certain extent of the intensification of fish parasitological research, as the improvement of fish production can be achieved from healthy fish stock only.

During the last five decades, lot of work has been done on the morphology and taxonomy of parasites of fishes. These researches have contributed a lot to our knowledge of many genera and species, both known and new. Still our knowledge on fish parasites and diseases is very meagre and we have no knowledge of the amount of damage caused and loss incurred in total fish production and fish products due to parasites and parasitic diseases.

With the above back ground in mind, the present study was undertaken. The studies presented in the thesis are based on the study of material collected from extensive survey of digenetic trematodes from Betwa and Ken rivers passing through the Bundelkhand region only.

The Bundelkhand region has a number of small and large water bodies, lakes, dams and two rivers which provide better fisheries and aquaculture prospects.

This region forms South-east boundry of Uttar Pradesh, extending from 24.21' to 26.42' North latitutde and 78.14' to 81.38' East longitude. It is comprised of five districts, namely - Jhansi, Lalitpur, Jalaun, Hamirpur and Banda. The region is surrounded in northern side by the districts of Etawah, Kanpur, Fatehpur and Allahabad of Uttar Pradesh.; in Western side by the districts of Guna, Shivpuri and Datia of Madhya Pradesh.; and in Southern side by the Districts of Sagar, Chattarpur, Panna of Madhya Pradesh.

The Betwa and Ken are the only two major rivers of this region which extend from one end of Bundelkhand region to the other. The water remains in them throughout the year. All popular groups of fishes form the bulk of total production of this region. The daily fish-output from this

region is 30 to 40 metric tons in off season and 50 to 80 metric tons during the season. The whole collection is exported to different important areas of the country after satisfying the regional requirements. All popular groups of fishes such as major carps, cat fishes, live fishes, feather backs, sheet fishes, eels etc. form the bulk of total production of this region.

The present work pertains to a group of air-breathing fishes, commonly available in fresh water bodies of the region namely ***Clarias batrachus*** (Linn.), ***Heteropneustes fossilis*** (Bl.) and species of ***Channa***. These include ***Channa punctatus*** (Bl.), ***Channa striatus*** (Bl.) and ***Channa marulius*** (Ham.). Out of the five species of ***Channa*** available in Uttar Pradesh, ***Channa gachua*** (Ham.), ***Channa marulius*** (Ham.), ***Channa punctatus*** (Bl.), ***Channa striatus*** (Bl.) and ***Channa leucopunctatus*** (Bl.), only the above mentioned three species are available in the water of Mathura district. These fishes are predatory in nature. Since these fishes remain alive for a long period out of water, so they are usually marketed alive and also known as live fishes. These fishes are easy to handle in laboratory. Though these fishes are mostly non-commercial, yet they have their own economic value and great demand due to their high protein, high iron and low fat contents compared to that in carps. ***Clarias batrachus*** (Linn.) and ***H. fossilis*** (Bl.) are considered to be highly nutritous

and esteemed as food where as species of ***Channa*** are eaten mostly by poor classes.

Thus efforts have been made to concentrate the work on these host fishes and to obtain maximum number of parasites from them throughout the period of study.

In order to make the faunistic studies more elaborate and objective, host-parasite relationship has also been studied and analysed statistically, in order to study index of total helminth infection; host-wise analysis; overall incidence; level and intensity of parasitization; seasonal incidence; and intensity of infection in trematodes. Such calculations can help considerably in the correct understanding of the nature and extent of their pathogenic role.

The present findings definitely contribute to the general survey of the parasitic fauna of this region. It may help the pisciculturists in understanding better the effect of parasitization on the fishes, thus helping to increase the production of fish as food to human beings.

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HISTORICAL RESUME

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Helminth parasites have been known to mankind since Vedic and Post-vedic periods around 800 B.C. as in ***Atharvaveda*** these worms are referred to as ***Krimis***. Great medical treatises of Charak and Susruta (between 200 B.C. and 200 A.D.) even mentioned detailed treatment of parasites. A detailed account of knowledge of these worms in ancient India is given by Bhaduri, Tiwari and Biswas (1972).

Our present day knowledge of helminth parasites dates back to 1379, when Jehan-de-Brie (1379) who for the first time discovered fluke ***Fasciola***. The first references to trematodes, probably ***Fasciola jacksoni*** and ***Pseudodiscus hawkesi***, from Indian region in modern times is made by Gilchrist, who has worked on them in the years 1841-1846. Later on, Cobbold (1869-1882) wrote a series of papers describing parasites of elephant, cattle and Gangetic dolphin and thus making the begining of the scientific study of trematode fauna of India.

Bhalerao (1926) was the first Indian helminthologist to give a boost to Indian helminthology in general and study of trematodes in particular. He was followed by a band of dedicated workers like Mehra, verma, Moghe, Thapar, lal, Srivastava (H.D.), Chauhan, Pande

and many others, who contributed much to our present day knowledge of the trematodes from Indian region. Bhalerao (1930) reviewed the progress of the knowledge of trematodes in India till that time In 1956, Thapar and Chauhan in 1963 also discussed the progress of helinthology in India with special reference to trematodes. Some of the more important contributions in this field include -

Bhalerao (1926, 36); Verma (1927, 36); Chauhan (1940, 49, 54, 55); Srivastava, H.D. (1938, 48); Mehra H.R. (1935, 38, 62, 66); Pande (1937); Patwardhan (1935); Khan (1935), Mehra, R.K. (1941); Kaw (1950); Dayal (1948, 49, 50); Baugh (1949, 50); Gupta (1950, 51, 55, 56); Jaiswal (1957); Jain (1967) and Pandey, K.C. (1970).

Helminth parasites of Indian fishes have not received the attention they deserve, except for the systematics of certain parasites. A perusal of literature shows that following Indian workers have described the trematode parasites of fishes -

Billet (1899) described ***Isoparorchis hypselobagri*** from ***Wallago attu*** and also immature forms of the some from ***Barbus tor***, ***Channa striatus***, ***Notopterus notopterus*** and ***Mastacembelus armatus*** from India.

Southwell (1913) described ***Isoparorchis trisimilitubis*** which was later renamed as ***I. hypselobagri*** from the air bladder of ***Wallago***

attu. Verma (1972) reported ***Opisthorchis pedicellata*** from the gall bladder of ***Rita rita***. He (1935) also recorded gastorostomes from siluroid fishes.

A large number of workers have made substantial contribution of the taxonomy of trematode parasites. These include -

Southwell and Prashad (1918) described ***Clinostomum piscidum*** and ***Nandus nandus***.

Verma (1927) described ***Opisthorchis pedicellata*** from ***Bagarius varrellii*** and ***Rita rita*** from Allahabad.

Thapar (1930) described ***Gomtia piscicola*** from ***Bagarius varrellii*** from Lucknow.

Srivastava, H.D. (1930) described ***Progonus Piscicola*** and ***Progonus ovocaudata*** from ***Ophiocephalus punctatus***; ***Ophiocorchis lobata*** and ***Ophiocorchis singularis*** from ***Ophiocephalus striatus*** from Allahabad.

Pande (1934) described ***Orientocreadium indicum*** from ***Heteropneustes fossilis*** and ***Rita buchanani*** from Allahabad. In 1937, he described ***Allocreadium handiai*** from ***Ophiocephalus punctatus***; In 1938, he described ***Allocreadium kosia*** from ***Barbus chilinoides***; ***Allocreadium schizothoracis*** from ***Schizothorax micropogon***; ***Allocreadium mahaseri*** from ***Barbus tor*** from Allahabad.

Dayal (1949) described ***Phyllodistomum vachius*** from ***Eutropiichthys vacha*** from Lucknow and Allahabad.

Bhalerao (1941) described ***Clinostomum indicum*** from ***Notopterus notopterus*** from Allahabad. In 1942, he described ***Clinostomum dasi*** from ***Saccobranchus fossilis*** and ***Clinostomum prashadi*** from an unidentified fish from Hyderabad.

Mehra (1941) described ***Opisthorchis pedicellata minutus*** from ***Mystus seenghala*** and ***Wallago attu*** from Allahabad.

Gupta (1950) described ***Allocreadium thapari*** from ***Rita rita*** from Hardoi. In 1951, he described ***Phyllodistomum singhiai*** from ***Mastacembelus armatus*** from Lucknow and Saharanpur. In 1953, he described ***Haplorchoides seenghali*** from ***Macrones seenghala***; ***Phyllodistomum vittatusi*** from ***Macrones vittatus***; ***Haplorchoides ritai***, ***Haplorchoides brahamputraensis*** from ***Rita rita*** from Assam; ***Haplorchoides gomtioensis*** from ***Silundia gangetica*** from Lucknow. In 1956, he described ***Allocreadium kamali*** from ***Chela bacaila***, ***Allocreadium mehrai*** from ***Rhychobadella aculeata*** from Lucknow. In 1963, he described ***Allocreadium makundai*** from Barbus sarana from Banaras.

Gupta and Verma (1976 Publ. 1977) described ***Allocreadium mrigali***, ***Allocreadium baranai***, ***Allocreadium saranai*** from ***Cirrhina mrigala***, ***Barilius barana*** and ***Barbus sarana*** respectively.

Kaw (1950) described ***Allocreadium nemacheilus*** from ***Nemacheilus kashmirensis***; ***Clinostomum schizothoroxi*** from ***Oreinus sinatus***, ***Schizothorax micropogon***; ***Phyllodistomum loossi*** from ***Schizothorax socinus*** from Kashmir.

Jaiswal (1957) described ***Phyllodistomum (Catroptoides) indianum*** from ***Heteropneustes fossilis*** and ***Phyllodistomum parorchium*** from ***Glossogobius (Gobius) giuris***; ***Euclinostomum chanai*** from ***Ophiocephalus punctatus***; ***Clinostomum macrosomium*** from ***Mastacembelus armatus*** from Hyderabad.

Saksena (1958) described ***Orientocreadium raipurensis***, ***Orientocreadium dayali*** from ***Clarias batrachus***; ***Allocreadium spindala*** from ***Mastacembelus armatus*** from Raipur. In 1960, he described ***Orientocreadium umadasi*** from ***Clarias batrachus*** from Raipur.

Srivastava, P.S. (1960) described ***Allocreadium ophiocephali*** from ***Ophiocephalus punctatus*** from Raipur.

Motwani and Srivastava (1961) described ***Phyllodistomum chauhani*** from ***Mystus tor*** and ***Mystus seenghala***; ***Phyllodistomum tripathi*** from ***Bagarius bagarius*** from India.

Rai (1962) described ***Allocreadium dollfusi***, ***Allocreadium singhi***, ***Allocreadium hirnai*** from ***Barbus tor*** from the River Hiran near Katangi and Sehora (M.P.).

Srivastava, C.B. (1962) described ***Pycnadena komiyai*** from ***Oxygaster gora*** from India.

Agrawal (1964) described ***Allocreadium heteropneustusius*** from ***Heteropneustes fossilis***; ***Haplorchoides macroni*** from ***Macrones seenaghala*** from Lucknow. In 1966, she described ***Genarchopsis punctati*** from ***Ophiocephalus punctatus*** from Lucknow.

Kakaji (1969) described ***Genarchopsis cameroni*** from ***Mystus seenghala***; ***Allocreadium catlai*** from ***Catla catla***; ***Genarchopsis cuchiai*** from ***Amphipnous cuchai*** from Lucknow. In the same year, she described ***Allocreadium guptai*** and ***Allocreadium fasciatusi*** from ***Rita rita*** and ***Trichoquaster fasciatus***, respectively from Varanasi.

Fotedar (1969) described ***Phyllodistomum megacotyle*** from ***Garra mullya*** from Kashmir.

Pande, B.P. and Shukla, R.P. (1976) described ***Haplorchoides pearsoni*** and ***Haplorchoides mehrai*** from ***Channa punctatus*** and ***Mystus vittatus***, respectively from Lucknow.

Gupta, V. and Puri, M. (1979, Publ. 1980) described ***Allocreadium calbassii***, ***Allocreadium manteri*** from ***Labeo calbasu***, ***Anabas testudineus***, respectively from Lucknow.

In Madhya Pradesh also, lot of work was done at Jabalpur, Raipur, Rewa, Ujjain and Gwalior by Singh, Agarwal, Dwivedi, Rai,

Saxena, Jain, Khoche, Johri, Dandotia and others. However, little work has been done on the helminth parasites of fishes of Bundelkhand region.

From the foregoing account, it is evident that considerable progress is being made in the knowledge of helminth fauna and its taxonomic study of this country, but very little work has been done to ascertain the incidence of parasites and estimation of helminthic infection. The important contributions in this field have been made by Srivastava, C.B. and Mukherjee, G.D. (1986); Siddiqui A.H.; Nizami, W.A. (1988), Devraj, M. & Rangnathan, V. (1991); Bhaduria, S. (1982), Dandotia, M.R. (1984, 1992, 1994) and others. Still a wide lacuna is left in this field considering the richness of fauna of parasite helminthes.

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MATERIAL AND METHOD

The host fishes were collected from rivers Betwa and Ken, dams and ponds and other local fresh water bodies of Bundelkhand region Fishes were also purchased from local fish markets.

These host fishes were kept alive in aquaria in the laboratory and then freshly killed, dissected and examined at convenience. A thorough search was done to determine the where abouts of parasites. Various organs particularly body cavity, stomach, duodenum, intestine, rectum, gall bladder and kidneys were carefully examined in petridish under the low poer binocular.

Soon after collection, the trematodes were thoroughly washed and kept in saline water. They were studied alive and observations were made regarding the colour and movements of body, spines on the body, oral and ventral suckers, cirrus and metraterm, excretory bladder and its branches.

For fixation 5-10% formaline was used. For whole mounts, preservation in formaline for longer periods gave good results. For preparing whole mounts, precaution was taken to avoid over or under pressure.

For preparing whole mount of trematodes, after fixation and thorough washing in water, worms were dehydrated and stained in Borox Carmine, then cleared in xylene and finally mounted in DPX. The drawings of the whole mounts were made with the help of camera lucida at a suitable magnification.

To record the seasonal incidence, the fishes were examined at regular intervals from July 1998 to June 2000. In all, 75 fishes per month with an average of 15 fishes per month of each species were examined. A total of 1800 fishes were collected and studied during two years period. The data collected was studied and statistically anaysed. This index of total helminth infection (Trematodes), host - wise analysis, overall incidence, level and intensity of parasitization, seasonal incidence and intensity of infection were calculated and analysed.

In the description all measurements are given in mm.

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A SYSTEMATIC LIST OF THE HOSTS EXAMINED

A SYSTEMATIC LIST OF THE HOSTS EXAMINED

	Class	Teleostomi
	Subclass	Actinopterygii
1.	Order	Cypriniformes
	Division	Siluri
	Sub-order	Siluroidei
(i)	Family	Clariidae
	Example	***Clarias batrachus*** (Linn.)
(ii)	Family	Saccobranchidae
	Example	***Heteropneustes fossilis*** (Bl.)
2.	Order	Ophiocephaliformes
(i)	Family	Ophiocephalidae
	Example	***Channa punctatus*** (Bl.)
	Example	***Channa striatus*** (Bl.)
	Example	***Channa marulius*** (Ham.)

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HOST - PARASITE LIST

Selected fresh water fishes have been examined for the present study of helminth parasites. These fishes are - ***Clarias batrachus*** (Linn.), ***Heteropneustes fosilis*** (Bl.) and sp. of ***Channa*** - namely: ***Channa punctatus*** (Bl.), ***Channa striatus*** (Bl.) and ***Channa marulius*** (Ham.) which are available locally and in the district in plenty. These live fishes were examined thoroughly for helminth infection and parasites were collected.

The following host - parasite list includes only the forms collected by the author and described in the present thesis. This includes species of digenetic trematodes only. Majority of the parasites form first host and locality record from this region and a new species recovered from ***Clarias batrachus*** and ***Heteropneustes fossilis***.

HOST - PARASITE LIST

Name of the host	Name of the parasite
Channa punctatus (Bl.)	***Genarchopsis singularis*** Srivastava, 1933
	Genarchopsis goppo Srivastava, 1933

	Genarchopsis piscicols
	Srivastava, 1933
	Orientocreadium indicum
	Pande, 1934
	Allocreadium handiai
	Pande, 1937
	Matacercaria of
	Euclinostomum heterostomum
	(Rudolphi, 1809) Travassos. 1928
	Isoparorchis hypselobagri
	(Billet, 1898) Odhner, 1911.
	Clinostomum complanadum
	(Rudolphi, 1819) Braun, 1899.
Channa striatus (Bl.)	***Genarchopsis singularis***
	Srivastava, 1933.
	Orientocreadium indicum
	Pande, 1934.
	Allocreadium handiai
	Pande, 1937.
	Metacercaria of
	Isoparorchis hypselobagri
	(Billet, 1898) Odhner, 1911.

Channa marulius (Ham.)	***Orientocreadium indicus***
	Pande, 1934.
	Matacercaria of
	Isoparorchis hypselobagri
	(Billet, 1898) Odhner, 1911.
Heteropneustes	***Orientocreadium indicum***
fossilis (Bl.)	Pande, 1934.
	Orientocreadium pseudobagri
	Yamaguti, 1934.
	Orientocreadium mathuransis n.sp.
	Allocreadium handiai
	Pande, 1937.
	Haplorchoides seenghali
	Dayal and Gupta, 1954.
	Phyllodistomum tripathi
	Motwani and Srivastava, 1961.
Clarias batrachus (Linn.)	***Orientocreadium indicum***
	Pande, 1934.
	Orientocreadium pseudobagri
	Yamaguti, 1934.
	Orientocreadium betwaensis n. sp.

Orientocreadium batrachoides

Tubangui, 1931.

Allocreadium handiai

Pande, 1937.

Pycnadena bariliusi

V.Kumari, 1937.

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PARASITE - HOST LIST

PARASITE - HOST LIST

PARASITE	HOST	LOCATION
Pycnadena bariliusi V.Kumari, 1973.	***Clarias batrachus*** (Linn.)	Stomach
Allocreadium handiai Pande, 1937.	***Clarias batrachus*** (Linn.)	Intestine
	Heteropneustes fossilis (Bl.)	intestine
	Channa punctatus (Bl.)	Intestine
	Channa striatus (Bl.)	Intestine
Orientocreadium batrachoides Tubangui, 1931.	***Clarias batrachus*** (Linn.)	Intestine
Orientocreadium indicum Pande, 1934.	***Clarias batrachus*** (Linn.)	Intestine
	Heteropneustes fossilis (Bl.)	Intestine
	Channa punctatus (Bl.)	Intestine
	Channa striatus (Bl.)	Intestine
	Channa marulius (Ham.)	Intestine
Orientocreadium pseudobagri Yamaguti, 1934.	***Clarias batrachus*** (Linn.)	Intestine

PARASITE	HOST	LOCATION
Orientocreadium betwaensis n. sp.	***Clarias batrachus*** (Linn.) ***Heteropneustes fossilis*** (Bl.)	Intestine Intestine
Phyllodistomum tripathi Motwani and Srivastava, 1961.	***Heteropneustes fossilis*** (Bl.)	Intestine
Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911	***Channa punctatus*** (Bl.) ***Channa striatus*** (Bl.) ***Channa marulius*** (Bl.)	Body Cavity Body Cavity Body Cavity
Genarchopsis piscicola Srivastava, 1933.	***Channa punctatus*** (Bl.)	Intestine
Genarchopsis goppo Srivastava, 1933.	***Channa punctatus*** (Bl.)	Intestine
Genarchopsis singularis Srivastava, 1933.	***Channa punctatus*** (Bl.) ***Channa striatus*** (Bl.)	Intestine Intestine
Euclinostomum heterostomum (Rudolphi, 1809) Travassos, 1928.	***Channa punctatus*** (Bl.)	Body cavity
Clinostomum complanatum (Rudolphi, 1819) Braun, 1899.	***Channa punctatus*** (Bl.)	Body cavity
Haplorchoides seenghali Dayal and Gupta, 1954.	***Heteropneustes fossilis*** (Bl.)	Intestine

PART - II

MORPHOLOGY AND TAXONOMY OF CERTAIN TREMATODES

Family : FELLODISTOMIDAE Nicoll, 1913

Subfamily : FELLODISTOMINAE Nicoll, 1909

Genus : *Pycnadena* Linton, 1911

Pycnadena bariliusi Kumar, 1973

(Fig. 1.)

One specimen of this species was collected from the stomach of ***Clarias batrachus*** (Linn.) out of 360 host specimens examined during the study period. The fishes were procured from the river Betwa and local fish market at Jhansi.

Description :

Body plump and stout, rounded anterior and broad posterior extremities, measures 0.85 x 0.30. Cuticle smooth. Oral sucker small, subterminal, oval, 0.12 - 0.9. Prepharynx absent. Pharynx large, muscular, oval, measures 0.8 x 0.05. Oesophagus small. Intestinal caeca extending upto a little anterior to hind end of the body. Acetabulum large, rounded, pre-equatorial, measures 0.32 x 0.27.

Testes oval, small, symmetrical, postacetabular, postequatorial. The left testis is slightly larger and measures 0.19 x 0.06. The right testis measures 0.10 x 0.05 Post-testicular space long. Cirrus pouch small, overlapping anterior margin of acetabulum. Genital pore immediately on the anterior margin of the acetabulum.

Ovary pretesticular and intertesticular, submedian, diagonally oval, measures 0.17 x 0.010. Receptaculum seminis large. Uterus very extensive, ascending and descending coils extend from pharynx to posterior end of the body. Eggs numerous, oval, yellow, small. Vitelline follicles lateral, extending from oral sucker to posterior end of the body, confluent in post-testicular region.

Discussion :

Linton (1911) proposed the name ***Pycnadena*** to replace the generic name **Didymorchis** erected by him in 1910, since it was preoccupied. Srivastava, C.B. (1962) described ***Pycnadena komiyai*** and placed it under the family ***Allocreadiidae*** following Yamaguti (1958), Manter (1947), Skrjabin and Koval (1957) placed it under the family Fellodistomidae. In the present study latter arrangement is accepted.

This species resumbles ***P. africana*** Fischthal and William (1971) in the shape of the body and in having longer hindbody and post-

testicular space but differs from it in the absence of post-oral ring, in the shape and size of cirrus sac, which is small instead of long and retortshaped, position of genital pore, which is on the anterior margin of acetabulum instead of posterior part of pharynx, size of the testes, which are much smaller than ovary, extension of uterus up to hind end of the body, eggs with occulated miracidia and in principal body measurement.

This species also resumbles ***P. lata*** (Linton 1910) in the shape of the cirrus sac, position of genital pore but differs from it in the absence of post-oral ring, in having longer hind body and post-testicular space, posterior extension of uterus and eggs with occulated miracidia.

The present specimen occupies an intermediate position showing affinities to both ***P. africana*** and ***P. lata***, but has its individual characteristics particularly in having testes symmetrical, posttesticular extension of uterus and embryonated eggs with occulate miracidia and absence of post-oral ring. The present species as such has been described as ***Pycnadena bariliusi***.

The present specimen in my collection forms the first host and locality record from this region.

Host : Clarias batrachus (Linn.)

Location : Stomach

Locality : Jhansi (U.P.)

Emended key to the species of the genus *Pycnadena* :

1. Postoral muscular ring present — 2
   Post-oral muscular ring absent — 4

2. Body-broad, oval, nearly as broad as long or breadth equal to 3/4 length, gonads situated near posterior extremity — 3

   Body oval, hind body larger, gonads in anterior half of hind body — ***P. africans***

3. Cirrus pouch short, lying at the anterior border of acetabulum; genital pore median at the base of pharynx, vitellaria diffused extending from pharynx to hind end of the body — ***P. lata***

Cirrus pouch long, slender, genital pore submedian, near left margin of body, at level of anterior margin of pharynx; vitellaria very limited extending from anterior margin of acetabulum to ends of intestinal caeca. ***P.pyriformae***

4. Testes symmetrical, uterus extending up to posterior end of the body, eggs with occulated embryos : ***P. bariliusi***

Testes tandem, uterus extending up to testes, eggs not embryonated, parasites of fresh water fishes ***P. komiyai***

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Family : ALLOCREADIIDAE Stossich, 1903

Subfamily : ALLOCREADIINAE Looss, 1902

Genus : *Allocreadium* Looss, 1900

Allocreadium handiai Pande, 1937

(Fig. 2.)

Twenty eight samples of this species were collected from the intestine of ***Clarias batrachus*** (Linn.); ***Heteropneustes fossilis*** (Bl.); ***Channa punctatus*** and ***Channa striatus*** (Bl.) procured from river Betwa in district Jhansi (U.P.).

Description :

Body small to large, aspinose, elongated with rounded anterior and posterior extremities, measures 0.75 - 2.8 x 0.28 - 0.53. Oral sucker subterminal, spherical, measures 0.15 - 0.24 x 0.13 - 0.24. Prepharynx absent. Pharynx oval, muscular, 0.05 - 0.09 x 0.05 - 0.09 in size. Oesophagus moderately long, 0.05 - 0.13. Intestinal bifurcation between pharynx and genital pore and caeca extend a little anterior to posterior extremity overlapped by vitellaria. Acetabulum spherical, smaller than oral sucker, pre-equatorial, measures 0.07 - 0.15 in diameter.

Testes obliquely tandem, median, spherical or oval, postacetabular, intercaecal. Anterior testis smaller than posterior testis and measures 0.03 - 0.24 x 0.05 - 0.24. Posterior testis measures 0.078 - 0.25 x 0.05 - 0.24. Cirrus sac oval to club shaped, situated in between intestinal bifurcation and acetabulum, measures 0.08 - 0.18 x 0.03 - 0.11. Vesicula seminalis bipartite.

Ovary small, oval, submedian or median, attached to acetabulum, measures, 0.05 - 0.17 x 0.04 - 0.10. Receptaculum seminis and Laurer's canal present. Shell gland complex large, uterus pretesticular. Vitellaria consists of large number of follicles extending from posterior margin of acetabulum and reaching almost upto hind end of the body and almost confluent in post-testicular region.

Excretory bladder tubular extending upto posterior border of posterior testis. Eggs large, yellow, oval embryonated, filamented and measures 0.07 - 0.10 x 0.03 - 0.05.

Discussion :

This species has been described by Pande (1937) from the intestine of ***Channa punctatus*** from Handia, Allahabad and Haldwani. Kaw (1950) recorded this species from some other vertebrates. Coil and Kuntz (1960) described it from small intestine of ***Channa punctatus*** from Dacca (Bangla Desh).

Eight species have been described under the genus Allocreadium Looss, 1902 from India. These include - ***A. annandalei*** Southwell, 1913; ***A. handiai*** Pandey, 1937; ***A. kosia*** Pande, 1938; ***A. schizothoracis*** Pande, 1938; ***A. nemachilus*** Kaw, 1950. ***A. thapari*** Gupta, 1950; ***A. mehrai*** Gupta, 1956; ***A. kamalai*** Gupta, 1956; ***A. ophiocephali*** Srivastava, 1960 and ***A. mukundi*** Gupta, 1963. Mehra (1966) considered ***A. thapari*** and ***A. ophiocephali*** conspecific with ***A. handiai***.

From the study of these specimens it is observed that there is variation in the shape of the body (small and oval or large and elongated), in the size of two suckers, the position of testes (varying from very close to acetabulum to midway between acetabulum and hind end of the body), the position of ovary post acetabular or lateral to posterior half of the acetabulum and in the anterior extension of vitellaria upto acetabulum or posterior to it. All these have been considered to be individual variations and the specimens are referred to as ***Allocreadium handiai*** Pande, 1937.

This species have been recorded for the first time from a number of fresh water fishes - ***Clarias batrachus*** (Linn.), ***Heteropneustes fossilis*** (Bl.), ***Channa punctatus*** (Bl.) and ***Channa striatus*** (Bl.) procured from Betwa river in district Jhansi, thus it forms multiple host and new locality record .

Host : *Clarias batrachus* (Linn.)

Heteropneustes fossilis (Bl.)

Channa striatus (Bl.)

Channa punctatus (Bl.)

Location : Intestine

Locality : Betwa river, district Jhansi (U.P.)

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Family : ALLOCREADIIDAE Stossich, 1903

Subfamily : ORIENTOCREADIINAE Yamaguti, 1958

Genus : ***Orientocreadium*** Tubangui, 1931

Orientocreadium batrachoides Tubangui, 1931

(Fig. 3.)

Two samples of ***Orientocreadium batrachoides*** were collected from the intestine of ***Clarias batrachus*** (Linn.) during the two year study period from a pond at Ralhai in district Jhansi (U.P.).

Description :

The body is spinose, elongated, spindle shaped, with rounded anterior and blunt posterior end, measure 1.586 x 0.32. The maximum breadth is at the level of anterior testis. Oral sucker is subterminal, rounded and measures 0.14 x 0.15. Acetabulum is submedian, rounded and measures 0.14 x 0.15 roughly equal to the oral sucker. Prepharynx is large, measures 0.017 x 0.045. Pharynx is well developed, measures 0.078 x 0.082. Oesophagus is very small. Intestinal caecae are simple, long, terminating at posterior extremity.

The testes are rounded, entire, sub-equal, tandem, postequatorial, measuring 0.13 - 0.15 x 0.28 - 0.25. Cirrus sac is long, curved, lying lateral to acetabulum and extends well behind it. It contains a vesicula seminalis interna, pars-prostatica and cirrus. Vesicula seminalis externa is long, saccular. Male and female genital opening are separate, preacetabular and median.

Ovary is oval, pretesticular, equatorial, intercaecal, lying between acetabulum and anterior testis and measures 0.12 x 0.26. Receptaculum seminis is present. Vitelline follicles extend from the level of ovary upto hind end of the body. In post-testicular region, the follicles of two sides merge together. Eggs numerous, oval and measures 0.18 x 0.011.

Excretory bladder is tubular with terminal excretory pore.

Discussion :

The genus ***Orientocreadium*** was established by Tubangui in 1931 to include ***Orientocreadium batrachoides***, parasitic in ***Clarias batrachus*** (Linn.). In 1934, Yamaguti added ***Orientocreadium indicum*** from ***Rita buchanani*** and ***Orientocreadium pseudobagri*** from ***Pseudobagrus aurantiacus***. He considered the genera ***Ganada*** Chatterji, 1933; ***Neoganada*** Dayal, 1938 as synonymous with the genus ***Orientocreadium*** and also transferred their species under it.

The type species ***Orientocreadium batrachoides*** Tubangui has been described in detail by many workers with little variations. These include Beverley - Burton (1962) from ***Clarias mossambicus*** and ***Clarias mellandia***; Fischthal and Kuntz (1963), Kakaji (1969) from ***Rita rita***; Pandey (1971) from ***Ophiocephalus punctatus*** and Jain and Chandra (1977) from ***Channa punctatus***.

Yamaguti (1958) has described twelve species under the genus ***Orientocreadium***. ***Orientocreadium ottoi*** has been considered a synonym of ***O. batrachoides*** Tubangui, 1931.

This species has not been described from this locality, it is recorded herein.

Host : ***Clarias batrachus*** (Linn.)

Location : Intestine

Locality : Ralhai, District Jhansi (U.P.)

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Family : ALLOCREADIIDAE Stossich, 1903

Subfamily : ORIENTOCREADIINAE Yamaguti, 1958

Genus : ***Orientocreadium*** Tubangui, 1931

Orientocreadium indicum Pande, 1934

(Fig. 4.)

The author collected 127 specimens of a trematode belonging to the genus ***Orientocreadium*** Tubangui, 1931 from the intestine of ***Clarias batrachus*** (Linn.). In all 360 specimens of the said host were examined of which 21 were found infected. This parasite was also recovered from the intestine of ***Heteropneustes fossilis*** (Bl.). 360 specimens of this host were examined of which three were found infected and seven specimens were collected. All the three species of ***Channa*** - namely ***Channa punctatus*** (Bl.), ***Channa striatus*** (Bl.) and ***Channa marulius*** (Ham.) available locally were found heavily infected with this trematode. Thus out of 360 specimens of ***Channa punctatus*** examined, ten treamatodes of this species were collected from three host specimens. Out of 360 specimens of ***Channa striatus*** examined, three fishes were found infected and

six trematodes were collected; out of 360 specimens of ***Channa marulius*** one was found infected with three specimens of this parasite.

On subsequent study it appears to be ***Orientocreadium indicum*** Pande, 1934 and has been described as such.

Description :

Body small, elongated, spinose with rounded anterior and bluntly tapering posterior extremities, measuring 1.2 - 2.5 x 0.24 - 0.34, maximum width being in preequatorial region. Oral sucker spherical, subterminal, 0.08 - 0.13 x 0.10 - 0.13. Well developed prepharynx is present, 0.05 - 0.09 in length, followed by muscular pharynx 0.08 - 0.10 x 0.09 - 0.11. Oesophagus very small. Intestinal caecae long, reaching upto posterior end. Acetabulum spherical, pre-equatorial, almost equal to oral sucker, measuring 0.13 - 0.19.

Testes median, post-equatorial with entire margin, measures 0.14 - 0.19 x 0.09 - 0.14 and 0.15 - 0.21 x 0.09 - 0.14 respectively. Cirrus Sac large, spined, crescent shaped to the right of acetabulum, 0.24 - 0.32 in length, enclosing pear shaped vesicula seminalis. pars prostatica, ejaculatory duct and protrucible cirrus. Vesicula seminalis externa in between ovary and acetabulum is present. Genital pore submedian, preacetabular.

Ovary median or submedian, postequatorial, situated midway between acetabulum and anterior testis, spherical, 0.09 - 0.12 x 0.06 - 0.10. Receptaculum seminis is absent, Laurer's canal is present. Uterus extensive, occupying the whole postacetabular space, terminating in metraterm, opening in genital atrium. Vitellaria extend from the anterior border of ovary to posterior end of the body, where the follicles of the two sides meet. Eggs numerous, oval, operculate, yellow 0.030 - 0.36 x 0.010 - 0.017.

Excretory bladder extending upto posterior margin of testes, excretory pore terminal.

Discussion :

Pande (1934) described the new species ***Orientocreadium indicum*** from the intestine of ***Rita buchanani*** from river Gomati at Jaunpur, Utter Pradesh. This specis differed from type species ***O. batrachoides*** Tubangui, 1931 by the presence of spined cirrus and metraterm, spherical ovary instead of oval, maximum width in pre-equatorial region, vitellaria extending from posterior margin of acetabulum of posterior end of body where the follicles of two sides meet without forming lattice.

Yamaguti (1954, 1958), Saksena (1958, 1960), Gupta (1961) and Khalil (1961) accepted it as a valid species. Fischthal and

Kuntz (1963) also accepted ***O. indicum*** as a valid species, characterised by the presence of spined cirrus and metraterm, the characters lacking in ***O. batrachoides*** and completely overlooked by Beverley - Burtan. Thus ***O. indicum*** is a valid species.

The present material forms new host and locality record. For the first time the specimen has been recorded from a number of air - breathing fishes like ***Clarias batrachus*** (Linn.), ***Heteropneustes fossilis*** (Bl.), ***Channa punctatus*** (Bl.), ***Channa striatus*** (Bl.) and ***Channa marulius*** (Ham.).

Host : ***Clarias batrachus*** (Linn.)

: ***Heteropneustes fossilis*** (Bl.)

: ***Channa punctatus*** (Bl.)

: ***Channa striatus*** (Bl.)

: ***Channa marulius*** (Ham.)

Location : Intestine

Locality : Ralhai, Jhansi (U.P.)

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Family : ALLOCREADIIDAE Stossich, 1903

Subfamily : ORIENTOCREADIINAE Yamaguti, 1958

Genus : *Orientocreadium* Tubangui 1931

Orientocreadium pseudobagri Yamaguti, 1934

(Fig. 5.)

The author collected 17 specimens of a trematode belonging to the genus ***Orientocreadium*** Tubangui, 1931 from the intestine of ***Clarias batrachus*** (Linn.). In all 360 specimens of the said host were procured from the river Betwa in Jhansi and examined, of which eight were found infected. This parasite was also recovered from the intestine of ***Heteropneustes fossilis*** (Bl.). 360 specimens of this host were examined of which two were found infected and four parasites were collected. This parasite was also recovered from the intestine of ***Channa punctatus*** (Bl.). 360 specimens of this host were examined of which three were found infected and four trematodeds were collected.

Description :

Body spindle shaped, spinose with rounded anterior end and

bluntly tapering posterior extremity, measures 2.8 - 3.10 x 0.53 - 0.55. Oral sucker is simple, subterminal, oval, 0.12 - 0.14 x 0.14 - 0.17. Prepharynx is short. Pharynx comparatively large, oval, 0.038 - 0.09 x 0.13 - 0.14. Oesophagus long, measures 0.33 - 0.39. Intestinal caecae long and reach nearly upto posterior extremity of body. Acetabulum spherical, pre-equatorial 0.16 - 0.18.

Testes postequatorial, entire, oval or spherical, subequal or equal, tandem and measuring 0.17 - 0.20 x 0.19 - 0.21 and 0.18 - 0.21 x 0.18 - 0.20. The vesicula seminalis externa and vesicula seminalis interna are present. Vesicula seminalis externa occupies expanded basal part of the cirrus pouch and is elongated and oval in shape; vesicula seminalis interna is short, retort shaped, lies infront of ovary. The cirrus pouch is crescent shaped, running close to acetabulum on its right side, opening into genital atrium. Genital pore is preacetabular, submedian and postbifurcal.

Ovary is pretesticular, round to oval, median, lies between acetabulum and anterior testis and measures 0.16 - 0.17. Shellgland complex behind the ovary. Uterus extends upto hind end of the body. Eggs numerous, oval, yellow, 0.020 - 0.026 x 0.005 - 0.008. Vitelline follicles extend from the mid acetabular region upto the hind end of body beyond the post-testicular region.

Excretory bladder is wide with terminal excretory pore.

Discussion :

Tubangui (1931) created the genus ***Orientocreadium*** and placed it under the family Allocreadiidae and later (1933) under the subfamily ***Allocreadiinae***. McMullen (1937) erected the family Macroderoidae which was accepted by La Rue (1957) and Mehra (1966).

Yamaguti (1958) created the subfamily ***Orientocreadiinae*** to include the genera ***Orientocreadium*** and ***Macrotrema*** under the family ***Allocreadiidae***. In the present work the family Allocreadiidae has been accepted.

Yamaguti (1958) has described 12 species under the genus ***Orientocreadium***. The present specimens compare well with ***Orientocreadium pseudobagri*** Yamaguti, 1934, except some minor individual variations like oval oral sucker, small prepharynx, long oesophagus and extension of vitellaria halfway between the caudal testis and posterior tip of the body and cirrus pouch on the right side of acetabulum instead of overlaping it. These variations may be considered as individual variations, so the present specimens are reffered to as ***O. pseudobagri*** Yamaguti, 1934.

This is the first new locality record of this species.

Host : *Channa punctatus* (Bl.)

: *Heteropneustes fossilis* (Bl.)

: *Clarias batrachus* (Linn.)

Location : Intestine

Locality : Jhansi (U.P.)

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Family : ALLOCREADIIDAE Stossich, 1903

Subfamily : ORIENTOCREADIINAE Yamaguti, 1958

Genus : ***Orientocreadium*** Tubangui, 1931

Orientocreadium betwaensis n.sp.

(Fig. 6.)

Fifteen worms of this species were collected from the intestine of ***Clarias batrachus*** (Linn.) and ***Heteropneustes fossilis*** (Bl.) from the river Betwa in Jhansi (U.P.).

Description :

Body spinose, small, elongated, measures 1.6 - 1.9 x 0.27 - 0.37. Maximum width being in pre-equatorial region. Oral sucker sub-terminal, rounded 0.10 - 0.13 x 0.12 - 0.13. Prepharynx present, measures 0.02 - 0.05 in length. Pharynx spherical, muscular, measures 0.09 - 0.11 x 0.010 - 0.12. Oesophagus very small or absent. Intestinal caecae terminate at posterior extremity. Acetabulum spherical, pre-equatorial, 0.14 - 0.18.

Tested sub-median, transversely elongated, tandem, postequatorial, oval with entire margin, measures 0.12 - 0.17 x 0.07 x 0.07 -

0.12 and 0.13 - 0.19 x 0.07 - 0.12 respectively. Cirrus sac large, crescent shaped, 0.22 - 0.33 in length, situated to the right of the acetabulum, enclosing pear shaped vesicula seminalis, well developed pars prostatica, long, spined ejaculatory duct and pretrucible cirrus. Well developed coiled vesicula seminalis externa situated in between acetabulum and ovary. Genital pore preacetabular, submedian.

Ovary median, postequatorial, transversly elongated, situated midway between acetabulum and anterior testis, oval, 0.08 - 0.11 x 0.06 - 0.09. Shellgland complex posterolateral to ovary. Receptaculum seminis absent. The Laurer's canal present uterus very extensive, occupying the whole postacetabular space with descending and ascending coils. Vitellaria consists of large number of follicles, extending from posterior border of acetabulum to posterior end of the body. Eggs numerous, yellow, oval, operaculated, 0.023 - 0.034 x 0.011 - 0.016 mm in size.

Discussion :

The present species combined the characters of ***Orientocreadium indicum*** as well as ***O. pseudobagri*** but has its own distinctive features. It differs from both in having small body, transversely elongated ovary and testes, very small oesophagus, eggs rounded or oval.

Thus the present form differs from all other species. It is, therefore, regarded as a new species and thus a new form

Orientocreadium betwaensis has been added by the author in the present work.

This new form has been named after the name of the city Mathura, from where these worms were recovered.

Host : ***Clarias batrachus*** (Linn.)

: ***Heteropneustes fossilis*** (Bl.)

Location : Intestine

Locality : Jhansi (U.P.)

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Family : GORGODERIDAE Looss, 1901

Subfamily : PHYLLODISTOMINAE Yamaguti, 1958

Genus : ***Phyllodistomum*** Braun, 1899

Phyllodistomum tripathi Motwani & Srivastava, 1961

(Fig. 7.)

Twelve specimens of ***Phyllodistomum tripathi*** Motwani and Srivastava, 1961 were collected from the intestine of ***Heteropneustes fossilis*** (Bl.) during the two year study period from Patoda lake, in district Lalitpur (U.P.).

Description :

The body is aspinose, flask shaped, divisible into a narrow, tubular fore body and a foliate hind body with wavy margin and measures 1.63 x 2.31 mm in length and maximum width. 0.75 x 1.21 mm just behind the posterior margin of acetabulum. Oral sucker is terminal, rounded, measures 0.208 - 0.320 x 0.210 - 0.318 in size. Acetabulum is larger than oral sucker, intercaecal, circular and measures 0.298 - 0.380 x 0.242 - 0.380 in size. Prepharynx and pharynx are absent. Mouth directly leads in to oesophagus. Oesophagus

is tubular, measure 0.149 - 0.715 in length and bifurcates into two simple, unbranched intestinal caeca, which extend upto hind region of body.

The testes are two in number, deeply lobed, intercaecal postequatorial, obliquely tandem, placed in the expanded part of the body. They are more or less equal and measures 0.216 x 0.242 in size. Cirrus sac is absent. Seminal vesicle is saccular, postbifurcal, intercaecal and anterior to acetabulum. Testes are separated by uterine coils.

The overy is pretesticular, postacetabular, intercaecal, lobed, overlaps the right vitellaria and measures 0.098 - 0.210 x 0.136 - 0.325 in size. Receptaculum seminis is absent. Uterus with descending and ascending limbs, occupy intertesticular, post-testicular area, intercaecal and extracaecal. Its terminal part forms a muscular metraterm. The genital pore is situated behind the intestinal bifurcation, pre-acetabular, intercaecal, post bifurcal, pre-equatorial. The eggs are numerous, oval, operaculated, both embryonated and unembryonated, measure 0.014 - 0.016 mm in size.

Vitellaria consist of two lobed glands, lying behind the ventral sucker on each side of the body.

The excretory bladder is sigmoid with terminal excretory pore. Excretory pore is near posterior end of the body.

Discussion :

Genus ***Phyllodistomum*** was erected by Braun (1899) with ***Phyllodistomum folium*** (Olfeers, 1816) Braun, 1899 as the type. The parasites of this genus normally inhabit the urinary bladder and also the intestine of fishes. It is observed that the forms recorded from urinary bladder are invariably larger.

A total of 15 species (13 from fishes and 2 from amphibians) of the genus ***Phyllodistomum*** have been reported from India. A complete list has been given by Thomas (1958) and a key to Indian species by Gupta (1953). Rai (1971) has critically reviewed the Indian species of the genus ***Phyllodistomum*** and according to him the various species can be divided into three groups on the basis of relative size of oral sucker and acetabulum. The relative size of suckers, oral and ventral, is a specific character and is least variable in the species. Accordingly i.e. equal size of both suckers - ***P. loossi*** kaw, 1950; acetabulum smaller than oral sucker - ***P. vachius*** Dayal, 1949; ***P. vittatusi*** Gupta, 1953; ***P. chauhani*** Motwani and Srivastava, 1969 and acetabulum larger than oral sucker - ***P. simili*** Nybelin, 1926; ***P. lewisi*** Srivastava, H.D. 1938; ***P. singhiai*** Gupta 1951; ***P. tripathi*** Motwani and Srivastava, C.B. 1961 are described as valid species.

The present specimen in the collection of the author has acetabulum distinctly larger than oral sucker. ***P. simili*** Nybelin, 1926; ***P. tripathi*** Motwani and Srivastava 1961; ***P. folium*** Braun, 1899 exhibit this relative structure of suckers. The author is in agreement with Kakaji (1969) in considering ***P. tripathi*** Motwani and Srivastava, 1961 as a synonym of ***P. folium***, as the presence or absence of notch on the posterior end of the body and relative size of various organs except the suckers are variable characters.

To the best of my knowledge the present form in the collection of author is ***Phyllodistomum tripathi*** Motwani and Srivastava. 1961 with wavy margins having thick folds along the margins. These characters can be regarded as variable characters.

Host : ***Heteropneustes fossilis*** (Bl.)

Location : Intestine

Locality : Patoda lake, in district Lalitpur (U.P.).

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Family : ISOPARORCHIIDAE Poche, 1926

Genus : ***Isoparorchis*** Southwell, 1913

(Syn. ***Leptolecithum*** Kobayashi, 1915)

Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911

(Fig. 8.)

Metacercariae of this species were collected from the body cavity of ***Channa punctatus*** (Bl.), ***Channa striatus*** (Bl.) and ***Channa marulius*** (Ham.) during the months of April, January and September from the river Betwa at Shergarh in District Jhansi (U.P.).

Description :

Body large, cylindrical, unspined with thick cuticle, flesh coloured, transluscent when expanded, foliate with bluntly projected anterior and broadly rounded posterior extremity and measures 1.02 - 4.05 x 0.62 - 1.07. Oral sucker is subterminal, oval, 0.16 - 0.39 x 0.17 - 0.49. Prepharynx absent, pharynx well developed. Oesophagus indistinguishable. Intestinal caeca long, serpentine, extending to near posterior end of the body. Acetabulum is larger than oral sucker, rounded, situated in the anterior half of the body and measures

0.27 - 1.02. Gonads indistinguishable. Genital pore situated between the two suckers at a distance of 0.31 - 0.16.

Excretory vesicle Y-shaped, excretory pore terminal.

Discussion :

Isoparorchis hypselobagri (Billet, 1898) has been described as the type species of the genus ***Isoparorchis*** Southwell, 1913. The metacercaria of this species has been recorded from a number of fresh water fishes like ***Wallago attu*** and ***Barbus tor*** as has been listed by Pandey (1970) and Srivastava (1972). Srivastava (1977) discussed its host, distribution and relationships.

This writer has collected this specimen from all the species of ***Channa*** available locally. viz. ***Channa punctatus*** (Bl.), ***Channa striatus*** (Bl.) and ***Channa marulius*** (Ham.). This is the first host and locality record of the larva from District Jhansi (U.P.)

Host : ***Channa punctatus*** (Bl.)

: ***Channa striatus*** (Bl.)

: ***Channa marulius*** (Ham.)

Location : Body cavity

Locality : Shergarh, District Jhansi (U.P.)

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Family : HEMIURIDAE Luhe, 1901

Sub family : HALIPEGINAE Ejsmont, 1931

Genus : *Genarchopsis* Ozaki, 1925

Genarchopsis piscicola Srivastava, 1933

(Fig. 9.)

The present study is based on eight specimens of this species collected form intestine of ***Channa punctatus*** (Bl.). 360 specimens of ***Channa punctatus*** (Bl.) were procured from ponds at Nandpura and Chaiba in District Hamirpur and dissected, of which intestine of four fishes were found infected with ***Genarchopsis***.

Discription :

The body is small, fusiform, aspinose, muscular and measures 1.26 - 2.62 x 0.47 - 0.89. The oral sucker is subterminal, cuplike and measures 0.32 - 0.40 x 0.32 - 0.50. Acetabulum is large, postequatorial, well developed, muscular, almost spherical, measuring 0.60 - 0.87 x 0.61 - 0.87. The prepharynx is absent. Pharynx present, small and measures 0.11 - 0.13 x 0.02 - 0.19. Oesophagus absent, intestinal caecae long and sinuous, extending upto posterior margin of body where they unite.

Testes oval, postacetabular, slightly obliquely tandem, extracaecal and anterior testis measures 0.24 - 0.37 x 0.17 - 0.28 and posterior testis 0.24 - 0.37 x 0.17 - 0.33, respectively. The cirrus sac absent. Pars prostatica is tubular and convoluted. The ejaculatory duct is short and opens along with metraterm into a short hermaphroditic duct.

Ovary small, postacetabular, intercaecal, spherical, situated almost at the level of posterior testis and measuring 0.15 - 0.23 x 0.12 - 0.33. The uterine coils are intercaecal, extending posteriorly upto the hind border of the testes. The left vitelline follicles measure 0.12 - 0.33 x 0.9 0.42, while right follicles measure 0.18 - 0.52 x 0.07 - 0.28. The genital pore just below pharynx near the intestinal bifurcation.

Discussion :

Looss (1899) erected the genus ***Progonus*** for ***Mulleri*** Levinsen, 1881. He (1902) renamed it as ***Genarches*** thinking the name ***Progonus*** as preoccupied by the insect genus ***Progona*** Berg, 1886. Fuhrmann (1904, 1928). Odhner (1905) considered ***Progonus*** as valid. Ozaki (1925) proposed a new genus ***Genarchopsis*** to accomodate his new species ***G. goppo.*** Srivastava H.D. (1933) while accepting the name ***Progonus*** valid, considered the genus ***Genarchopsis*** as synonym of the former. He also erected a new genus ***Ophiocorchis*** to

accommodate his new species ***O. lobatum***. Yamaguti (1958, 1971) considered the genera ***Progonus***, ***Genarches***, *Ophiocorchis* as congeniric with ***Genarchopsis***. The former two being, in his opinion, preoccupied. This arrangement is more or less being followed by the subsequent workers. Rai (1971) made a detailed study of various Indian species related to the genus ***Ophiocorchis*** and ***Genarches*** and came to the conclusion that all indian species are synonyms of ***G. goppo*** Ozaki, 1925. He, however, did not deal with the question of the validity of the genus ***Progonus***. Srivastava, H.D. and Shahai (1978) tried to revalidate the genus ***Ophiocorchis***. The genus ***Progonus*** is not preoccupied as generally believed. According to Article 56 of International Rules of Zoological Nomenclature, the genera ***Genarchopsis***, and ***Ophiocorchis*** have, therefore, been related to the genus ***Progonus***.

The trematode under discussion has been compared with the valid species of genus ***Genarchopsis*** Ozaki. 1925 namely ***G. ovacaudatum***, ***G. piscicola*** and ***G. dasus***. It differs from ***G. ovacaudatum*** in the length and maximum width of the body. size of ovary, ratio of suckers and extension of uterine coils. It also differed from ***G. dasu*** (Gupta, 1951) in the length and maximum width of body, length and width of oral sucker, ratio of suckers and measurement of vesicula seminalis.

However, the worm approaches more closely to ***G. piscicola*** Srivastava, 1933 in the extension of uterine coils and principal body measurement, except for the differences in the length of the body, the ratio of suckers and the nature of the uterine coils. These variations are minor ones and do not suggest the proposition of a new species and so the present worms are referred to as ***Genarchopsis piscicola*** Srivastava, 1933.

Host : ***Channa punctatus*** (Bl.)

Location : Intestine

Locality : District Hamirpur (U.P.)

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Family : HEMIURIDAE Luhe, 1901

Sub family : HALIPEGINAE Ejsmont, 1931

Genus : *Genarchopsis* Ozaki, 1925

Genarchopsis goppo Srivastava, 1933

(Fig. 10.)

Out of 360 specimens of ***Channa punctatus*** (Bl.) examined, the intestine of one was found infected with two worms of genus ***Genarchopsis*** Ozaki, 1925. The fishes were procured from a pond at Shahpur in District Banda (U.P.).

Description :

Body elliptical with both extremities rounded and measuring 3.6 - 4.89 x 1.07 - 1.9. Maximum breadth in acetabular zone. Oral sucker oval, subterminal 0.32 - 0.36 x 0.39 - 0.44. Pharynx oval, 0.17 - 0.4 x 0.17 - 0.20. Acetabulum large, spherical, equatorial, 0.79 - 0.85 x 0.79 - 0.87.

Testes oval, postacetabular, almost at the same leval, right measuring 0.25 - 0.31 x 0.45 - 0.47 and left 0.35 - 0.36 x 0.44 - 0.45 respectively. The cirrus sac absent. Vesicula seminalis well

developed, long, cylindrical, postbifurcal, lying free in parenchyma which continues into oval, compact pars prostatica surrounded by prostate gland cells. Terminal part of pars prostatica joins with metraterm to form hermaphroditic duct. Genital pore submedian in level with pharynx.

Overy oval, post-testicular, 0.16 - 0.30 x 0.4 - 0.38 lying just below right testis. Shellgland complex postovarian. Receptaculum seminis uterinum present. Metraterm well developed, muscular, receiving pars prostatica at its distal end. Eggs with filament on one side. Vitellaria two lobed glands partly overlapping the intestinal caeca, lying in hind part of body.

Excretory bladder Y-shaped with the arms anastomosing dorsal to oral sucker.

Discussion :

Srivastava (1933) described the type species ***Progonus lobata*** (Srivastava, 1933) from the stomach of ***Channa striatus*** from Lucknow. Gupta (1951) described ***Genarchopsis faruguis*** from the intestine of ***Mastacembelus armatus*** which is considered as synonym of this species in the light of the variations observed. ***G. malanosticus*** Dwivedi, 1965 and ***G. cuchiai*** Kakaji, 1969 are considered co-specific with ***P. lobata*** as the characters used by them to differentiate their new species fall within the limit of variations.

The present specimen, therefore, has been described as type species ***Genarchopsis goppo*** Srivastava, 1933. This is the first locality record of this specimen from District Banda (U.P.)

Host : ***Channa punctatus*** (Bl.)

Location : Intestine

Locality : Shahpur, District Banda (U.P.)

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Family : HEMIURIDAE Luhe, 1901

Sub family : HALIPEGINAE Ejsmont, 1931

Genus : ***Genarchopsis*** Ozaki, 1925

(Syn. ***Progonus*** Looss, 1899 Preoccupied)

Genarchopsis singularis Srivastava, 1933

(Fig. 11.)

360 specimens of ***Channa punctatus*** (Bl.) and 360 specimens of ***Channa striatus*** (Bl.) were examined during present study. Out of these, four and one specimen were found infected respectively with ***Genarchopsis singularis*** Srivastava, 1933. In all ten worms were collected from the intestine of hosts. The fishes were procured from a pond at Rohta, in district Jalaun (U.P.).

Description :

Body small, oval, 0.98 - 3.32 x 0.49 - 0.86 with maximum breadth at acetabular zone. Oral sucker oval, subterminal, 0.13 - 0.33 x 0.19 - 0.37. Pharynx oval, 0.08 - 0.2 x 0.07 - 0.10. Oesophagus small.

Testes symmetrical, postacetabular, oval, overlapping intestinal

caeca, measuring 0.11 - 0.21 x 0.09 - 0.13 and 0.11 - 0.20 x 0.08 - 0.17 respectively. Cirrus sac absent.

Overy small, spherical, median, post-testicular, lying in the hind part of body, anterior to vitelline follicles, 0.067 - 0.22 x 0.087 - 0.16. Shellgland complex postovarian. Uterus with transverse coils extending posteriorly upto vitelline zone which continues anteriorly as metraterm and opens into pars prostatica. Eggs yellowish oval, 0.021 - 0.037 x 0.011 - 0.015 with a filament on one side. Vitellaria two, compact, oval glands one on either side in posterior most part of the body.

Excretory bladder Y-shapped with arms anastomosing dorsal to oral sucker.

Discussion :

Chauhan (1953) in the comprehensive work on the family Hemiuridae maintained the genera ***Progonus*** and ***Ophiocorchis*** synonyms of the genus ***Genarches*** and transferred their species under it. Yamaguti (1958) synonymised the genus ***Ophiocorchis*** Srivastava, 1933 (***Progonus*** Looss, 1899, Preoccupied; ***Genarches*** Looss, 1902 Preoccupied) with ***Genarchopsis*** Ozaki, 1925.

Srivastava (1933) described ***Ophiocorchis singularis*** from the intestine of ***Channa marulius*** at Allahabad. Gupta (1951) collected

some specimens from ***Channa punctatus*** at Lucknow and Saharanpur, U.P. and referred them to as new species ***Ophiocorchis indicum***. Chauhan (1954) remarked that the differences enumerated by Gupta do not merit the establishment of a new species and the two species should be considered indentical.

The present specimens have been collected from ***Channa punctatus*** and ***Channa striatus*** from a pond at Rohta, in district Jalaun (U.P.) and combine the characters of both the species. Thus, it is evident that ***O. indicum*** is conspecific with ***O. singularis*** as suspected by Chauhan (1954). The present collection, however, forms a new locality recorded.

Host : ***Channa punctatus*** (Bl.)

: ***Channa striatus*** (Bl.)

Location : Intestine

Locality : Rohta, District Jalaun (U.P.)

Key to the species of the genus *Progonus* Looss, 1899 :

1. Oesophageal pouch present
   Vitellaria lobed or compact 2

   Oesophageal pouch absent,
   Vitellaria compact 4

2.	Cirrus pouch present	*P. thapari*
	Cirrus pouch absent	3
3.	Vitelline glands distinctly lobed, acetabulum equatorial or postequatorial	*P. lobata*
	Vitelline glands compact or crenulated	*P. singularis*
4.	Vitellaria a little anterior to posterior extremity and uterus extending beyond vitellaria	*P. mulleri*
	Vitellaria near posterior extremity, Uterus extending upto vitellaria or still anterior to it	5
5.	Main mass of uterine loops anterior to acetabulum	*P. piscicola*
	Uterus equally anterior and posterior acetabulum	6
6.	Uterus mostly intercaecal	*P. goppo*
	Uterus extending in to extracaecal zone	*P. angullae*

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Family : CLINOSTOMIDAE Luhe, 1901

Genus : ***Clinostomum*** Leidy, 1856

Clinostomum complanatum (Rudolphi, 1819) Braun, 1899

(Metacercaria)

The author collected 40 specimens of ***Clinostomum complanatum*** (Rudolphi, 1819) Braun, 1899 throughout the year 1999 to 2000 from the body cavity of ***Channa punctatus*** (Bl.).

The parasite resembles with the description given by previous workers and hence no description and measurement have been recorded.

Host : ***Channa punctatus*** (Bl.)

Location : Body cavity

Locality : Rohta, District Jalaun (U.P.)

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Family : CLINOSTOMIDAE Luhe, 1901

Subfamily : EUCLINOSTOMINAE Yamaguti, 1958

Genus : ***Euclinostomum*** Travassos, 1928

Euclinostomum heterostomum (Rudolphi,1809) Travassos,1928

(Fig. 12.)

Metacercaria (Larval trematodes) of this species were collected in cysts from Body cavity of ***Channa punctatus*** (Bl.). Out of 360 specimens of ***Channa punctatus*** (Bl.) examined during 1998 to 2000, three fishes were found infected with these larval forms in the month of July and January. The fishes were procured from a pond at Rohta, in district Jalaun (U.P.)

Description :

Body large, oval, unspined with rounded extremities measures 4.9 - 5.7 x 2.42 - 3.03 with collor like formation at anterior end. Oral sucker very small, oval, subterminal measures 0.3 - 0.44 x 0.3 - 0.36. Pharyns small, thick walled, measures 0.13 - 0.16 x 0.16 - 0.18, surrounded by loosely arranged parenchymal muscles extending from posterior border of oral sucker to the base of collor,

roughly halfway between intestinal bifurcation and acetabulum. Larval eye - spots present on either side of pharynx. Oesophagus absent. Intestinal caeca very thin upto posterior border of acetabulum, after which lateral diverticulae start. Lateral diverticulae are single and branched terminally postero-lateral, extending upto lateral margins of the body. Their number being 11 on the left side and 12 on the right. Acetabulum very large, spherical, median, pre-equatorial, measuring 1.27 - 1.5 x 1.2 - 1.29 at a distance of 1.17 - 1.35 from anterior end.

Testes postequatorial tandem, median, intercaecal. Anterior testis crescent shaped and posterior testis Y or V-shaped, measuring 0.33 - 0.34 x 0.77 - 0.79 and 0.54 - 0.55 x 0.54 - 0.58 respectively. Vasa-efferentia of posterior testis running parallel to right caeca and joins with vasa-efferentia of the anterior testis, then enters the cirrus sac as vas-deferens. Cirrus sac small, oval, in front of anterior testis, in between its arms, enclosing bipartite seminal vesicle, pars prostatica and cirrus. Genital pore median, at the level of anterior third of cirrus sac.

Ovary small, oval, submedian, intertesticular, intercaecal, measuring 0.12 - 0.17 x 0.12 - 0.2. Oviduct, short arising from posterior border of ovary. Shellgland complex large, diagonally placed on one side of ovary. Metraterm very short and opens into genital atrium. Vitelline

follicles very small, immature, lateral, extending from posterior margin of acetabulum acetabulum upto posterior end of body and continuous in post-testicular region.

Discussion :

Travassos (1928) created the genus ***Euclinostomum*** with ***Euclinostomum heterostomum*** as its type species; a generic diagnosis was not given, Yamaguti (1958) created the subfamily ***Euclinostominae*** with ***Euclinostomum*** as its only genus.

The species ***E. heterostomum*** was first described as ***Distoma heterostomum*** by Rudolphi (1809). The description was rather brief and general dealing with external features and was without an illustration. Braun (1900) presented the first detailed account of the morphology of adult ***E. heterostomum*** from herons, ***Ardea purpurea***, ***A. cinerea*** and ***Nycticorax griseus***. Monning (1926) reported three metacercariae of ***E. heterostomum*** from the muscles of an unnamed fish. Joyeux and Houdemer (1928) recorded adult ***E. heterostomum*** from egrets, ***Gazetta garzetta***. Metacercariae were found by them in the muscles of the fish, ***Anabas scandens***.

Srivastava (1950) found metacercaria of ***E. heterostomum*** from ***Channa punctatus*** embeded in the liver and attached to the kidneys or muscles of the coelomic wall.

Adult worms occured naturally in the night heron, ***Nycticorax nycticorax***.

Euclinostomum indicum was described by Bhalerao (1942) from the body cavity of ***Channa punctatus***. Agrawal (1959) collected adult of ***E. indicum*** from herons, ***Bubulcus ibis*** fed with the fish, ***Channa punctatus***. Fischthal and Kuntz (1963) considered ***E. indicum*** (Bhalerao, 1942, metacercaria; Agrawal, 1959 adult) synonym of ***E. heterostomum***.

About a dozon species have been described so far under the genus ***Euclinostomum*** of which five are from our country viz ***E. heterostomum***, ***E. bhagvantami***, ***E. channai***. ***E. hepatocaecum*** and ***E. indicum***. The characters utilized by previous workers for differentiating the known species of ***Euclinostomum*** are all highly variable and which include, the body shape, the structure of prepharynx, pharynx, oesophagus, number and shape of caecal diverticula. Perusal of literature shows that ***E. heterostomum***, the type species the genus, enjoys a wide host range and occurs in different geographical locality throughout the world. Its metacercariae are found in fresh water fishes consequently wide morphological variations in the anatomy are natural in this species.

The present specimens agree with the description given by the Braun (1900) except in the presence of well developed pharynx

and vitellaria, which are considered as individual variations of ***E. heterostomum***.

Host : ***Channa punctatus*** (Bl.)

Location : Body cavity

Locality : Rohta, District Jalaun (U.P.)

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Family : HETEROPHYIDAE Odhner, 1914

Subfamily : HAPLORCHIINAE Looss, 1899

Genus : ***Haplorchoides*** Chen, 1949

Haplorchoides seenghali Dayal and Gupta, 1954

(Fig. 13.)

One specimen of this species was collected from the intestine of ***Heteropneustes fossilis*** (Bl.) out of 360 specimens of ***Heterpropneustes fossilis*** (Bl.) examined throughout the year 1998, 1999 and 2000. The fishes were procured from a pond at Gyasi in in District Lalitpur (U.P.).

Description :

Body very small, oval with rounded anterior and posterior extremities, 0.06 x 0.24. Oral sucker subterminal, spherical, 0.06 in diameter. Prepharynx 0.05 in length. Pharynx well oval, developed 0.015 x 0.011. Oesophagus 0.012 in length. Intestinal caecae terminating a little anterior to hind end of the body. Acetabulum absent.

Testis single, very large, oval, intercaecal, 0.09 x 0.12. Cirrus

pouch absent. Seminal vesicle bipartite. Genital sac globular, situated on left intestinal caecum.

Ovary small, median, pretesticular, spherical, 0.04 - 0.05. Uterus very extensive occupying the whole postbifurcal body, containing large, yellow, oval, filamented eggs occupying entire post-testicular region. Vitelline follicles extending from hind end of ovary to hind end of testis.

Discussion :

Chen (1949) established the genus ***Haplorchoides*** with ***H. cahirinus*** (Looss, 1869) as its type species.

The question of the validity of the genera ***Haplorchis*** Looss, 1899; ***Monorchotrema*** Nishigori, 1924 and Chen, 1949 have been discussed by several authors. Witenberg (1929 and 1930), Srivastava (1935), Chen (1936) and Dawes (1946) considered the synonymy of ***Monorchotrema*** to ***Haplorchis.***

Gohar (1934) and Dayal (1935) considered ***Haplorchis*** and ***Monorchotrema*** as distinct genera. Srivastava (1935) splitted the genus ***Haplorchis*** into two subgenera; ***Haplorchis (Monorchotrema)*** and ***Haplorchis (Haplorchis)***. The subgenus ***Haplorchis (Monorchotrema)*** is characterized in having prepharynx shorter than oesophagus, testis and vitellaria caudal in position and with a rudimentary

acetabulum, while the subgenus ***Haplorchis (Haplorchis)*** is characterized in having prepharynx longer than oesophagus, testes and vitellaria more anterior and the acetabulum being absent.

Chen (1936) considered the synonymity of the genera ***Haplorchis*** Looss, 1899 and ***Monorchotrema*** Nishigori, 1924 and considered ***Haplorchis*** to be the only valid genus and ***Monorchotrema*** to be identical and synonymous to it. In 1949, he differentiated the two genera ***Haplorchis*** Looss, 1899 and ***Haplorchoides*** n.g. on the basis of relative size of prepharynx and oesophagus, a short prepharynx, long oesophagus, thin-walled vesicula seminalis and more posterior position of testis and vitellaria, characterized ***Haplorchis*** while a long prepharynx, short rundimentary oesophagus and more forward position of testis and vitellaria characterized ***Haplorchoides.*** Yamaguti (1954) considered ***Pseudohaplorchis*** Dayal, 1949 as a synonym of ***Haplorchoides*** Chen, 1949.

Gupta (1953), Yamaguti (1958 and 1971) and Agrawal, 1964 accepted Chen's (1949) view and considered the genus ***Haplorchoides*** as distinct from ***Haplorchis*** whereas Chatterji (1953 and 1956) and Baugh (1963) considered ***Haplorchoides*** as synonym of ***Haplorchis.*** Later Pearson (1964) accepted this genus and placed it under the family Heterophyidae on the basis of the position and shape of excretory bladder. Rai and Pande (1967) agreed with Pearson (1964)

and placed it in the sub-family Haplorchiinae Looss, 1899 on the basis of the presence of armed acetabulum embedded inside the ventrogenital sac and saccular and post-testicular excretory bladder In the present study, the latter arrangement has been accepted.

Haplorchoides seenghali has been described by Dayal and Gupta (1954) from the intestine of ***Mystus seenghala***. Gupta (1955) gave complete description of the species but described it as a new species.

The present specimens resemble type specimen except for smaller size of body, in principal body measurements and very large size of testis, which may be regarded as variable characters. So the specimen is described as ***Haplorchoides seenghali*** Dayal and Gupta, 1954.

Host : ***Heteropneustes fossilis*** (Bl.)

Location : Intestine

Locality : Gyasi, District Lalitpur (U.P.)

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PART - III

HOST-PARASITE RELATIONSHIP AND SEASONAL INCIDENCE

HOST - PARASITE RELATIONSHIP

HOST-PARASITE RELATIONSHIP

Study of helminthological literature from India indicates that more attention has been paid to taxonomic studies of helminth worms. While the taxonomy forms the basis of all biological investigations, still it alone can not fulfill the objectives of parasitologists. Host-parasite relationship has to be given due weightage to assess the exact extent of damage caused by these parasites. Till now very little attention has been given to host-parasite relationship, population biology and estimation of helminth infection with regard to most of the species. These lacunae are mainly responsible for our failure in implementing our objectives and in combating helminth infections.

In order to make the faunistic studies more objective. host-parasite relationship has been studied and discussed in detail. Investigations on these relatively less explored branches are bound to reveal important clues for a correct understanding of the nature and extent of their pathogenic role.

A parasite is always under the influence of two types of environments - viz; the internal environment in which the parasite lives and the external environment in which the host lives. It is the interaction of the influence of these environments and the strategy adopted by the parasites to counter influence that develops the

host specificity and host-parasite relationship Thus the establishment and survival of helminths in their hosts is controlled by the internal environment of the host as well as its external environment.

Thus the major environmental factor that influence the incidence of helminth infection and host-parasite relationship are both biotic and abiotic. In the present study various abiotic factors including - Index of total helminth infection in trematodes, host - wise analysis, overall incidence, level and intensity of parasitization, seasonal incidence have been studied and statistically analysed, similarly biotic factors like the influence of sex of the host and size of the host have also been studied.

The climate of this region is subtropical and the seasons which can be recognised are the Winter season (Nov., Dec., Jan., Feb.,). Summer season (March, April, May, June) and Rainy season (July, Aug, Sept, Oct.).

The average atmospheric temperature ranges from 25.11°C (in Jan.) to 41.35°C (May) and minimum temperature ranges from 10.51°C (in Jan.) to 26.58°C (May). The temperature gradually shows a decreasing trend from July to December and increasing trend from January to May.

Relative humidity is more in morning (8.30 am) than in evening (5.30 pm). The minimum in morning hours was 24.90% in April

while maximum 85.35% was in the month of August. In the evening the lowest humidity values were 16.50% in May and highest 85.33% in August.

Since during the present study period trematodes formed the predominant helminth parasites, hence the present study is mainly concentrated on the host-parasite relationship of trematodes. As the cestode recovered was only one, and no nematodes were reported, so they are not being statistically analysed.

Under the present project, the helminth parasites of five different host fishes viz - ***Channa punctatus*** (Bl.); ***Channa striatus*** (Bl.); ***Channa marulius*** (Ham.); ***H. fossilis*** (Bl.) and ***Clarias batrachus*** (Linn.) were collected from July 1998 to June 1999 and from July 1999 to June 2000 . A total of 1800 host fishes were collected and examined regularly during that period. On an average fifteen fishes of each host species (Total about 75 fishes per month) were examined. The data thus collected has been statistically analysed.

INDEX OF TOTAL HELMINTH INFECTION (TREMATODES)

INDEX OF TOTAL HELMINTH INFECTION (TREMATODES)

A total of 1800 host fishes belonging to five host species were procured during two years period from July 1998 to June 2000. The data collected was analysed to determine percentage of total helminth infection.

TABLE - I

Month & Year		No.of Parasite recovered	Percentage of trematode infestation
July	98 - 99	28	18.66
August	98 - 99	70	46.66
September	98 - 99	29	19.33
October	98 - 99	26	17.33
November	98 - 99	27	18.00
December	98 - 99	24	16.00
January	99 - 2000	38	25.33
February	99 - 2000	28	18.66
March	99 - 2000	19	12.66
April	99 - 2000	16	1.66
May	99 - 2000	01	0.66
June	99 - 2000	02	1.33

It is clear from the above Table 1 that the highest % of trematode infestation was in the month of August and lowest in the month of May and June.

It was observed from separate study of year wise incidence, that the helminth infestation was relatively less in the year 1998-1999 as compared to that in 1999-00 i.e. there is a definite increase in the rate of helminth infestation during 1999-00 (Plate 14).

From the study of monthly fluctuation of trematode parasites, it is evident that the infection shows a decline during summer months prior to breeding season (May - June) and increases in rainy season. The reason for this may be that prior to breeding season, the fishes stop feeding for some time and so there is very little chance of their getting infected, but during rainy season water gets polluted, so the infestation rate is high.

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HOST - WISE ANALYSIS OF PARASITES

HOST-WISE ANALYSIS OF PARASITES

Host-wise analysis of various parasites recovered has been analysed in Table 2A, 2B, 2C, 2D & 2E respectively.

Channa punctatus (Bl.)

TABLE 2-A

Parasite	Habitat	Total No.of Parasites recorded during July 1998 to June 2000	Total No.of positive hosts	Month and Year in which infection was recorded
(a)	(b)	(c)	(d)	(e)
Genarchopsis singularis Srivastava, 1933	Intestine	8	4	July 1999 August 1999 December 1999 April 2000
Genarchopsis goppo Srivastava, 1933	Intestine	2	1	February 2000
Genarchopsis piscicola Srivastava, 1933	Intestine	8	4	September 1999 November 1999 December 1999 March 2000

(a)	(b)	(c)	(d)	(e)	
Orientocreadium indicum Pande, 1934	Intestine	10	3	July August November	1999 1999 1999
Orientocreadium pseudobagri Yamaguti, 1934	Intestine	4	3	August August November	1998 1999 1999
Allocreadium handiai Yamaguti, 1934	Intestine	5	4	November December July April	1998 1998 1999 2000
Metacercaria of ***Euclinostomum heterostomum*** (Rudolphi, 1809) Travassos, 1928	Body cavity	4	3	July January	1999 1999
Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911	Body cavity	3	1	April	1999
Clinostomum complanatum (Rudolphi, 1819) Braun, 1899	Body cavity	40	17	July to Dec Jan to June	1998 1999

Channa punctatus (Bl.)

TABLE 2-B

Parasite	Habitat	Total No.of Parasites recorded during July 1998 to June 2000	Total No.of positive hosts	Month and Year in which infection was recorded
(a)	(b)	(c)	(d)	(e)
Genarchopsis singularis Srivastava, 1933	Intestine	2	1	October 1999
Orientocreadium indicum Pande, 1934	Intestine	6	3	July 1999 September 1999 November 1999
Allocreadium handiai Pande, 1937	Intestine	3	2	August 1999 April 2000
Metacercaria of ***Isoparorchis hypselobagri*** (Billet, 1898) Odhner. 1911	Body cavity	2	1	January 2000

Channa marulius (Ham.)

TABLE 2-C

Parasite	Habitat	Total No.of Parasites recorded during July 1998 to June 2000	Total No.of positive hosts	Month and Year in which infection was recorded
(a)	(b)	(c)	(d)	(e)
Orientocreadium indicum Pande, 1934	Intestine	3	1	August 1999
Metacercaris of ***Isoparorchis hypselobagri*** (Billet, 1898) Odhner, 1911	Body cavity	2	1	September 1999

Heterpropneuster fossilis (Bl.)

TABLE 2-D

Parasite	Habitat	Total No.of Parasites recorded during July 1998 to June 2000	Total No.of positive hosts	Month and Year in which infection was recorded	
(a)	(b)	(c)	(d)	(e)	
Orientocreadium indicum Pande, 1934	Intestine	7	3	March July November	1999 1999 1999
Orientocreadium pseudobagri Yamaguti, 1934	Intestine	4	2	February February	1999 2000
Orientocreadium betwaensis n.sp.	Intestine	2	1	January	2000
Allocreadium handiai Pande, 1937	Intestine	5	1	February	1999
Haplorchoides seenghaii Dayal and Gupta, 1954	Intestine	1	1	February	2000
Phyllodistomum tripathi Motwani and Srivastava, 1961	Intestine	12	5	July August	1999 1999

Clarias batrachus (Linn.)

TABLE 2-E

Parasite	Habitat	Total No.of Parasites recorded during July 1998 to June 2000	Total No.of positive hosts	Month and Year in which infection was recorded
(a)	(b)	(c)	(d)	(e)
Orientocreadium indicum Pande, 1934	Intestine	127	21	Aug.,Sep.,Dec., 1999 Feb.,Mar.,Aug., Sep.,Oct.,Nov., December 1999 Jan.,Feb.,Mar., April 2000
Orientocreadium pseudobagri Yamaguti, 1934	Intestine	17	8	Aug.,Sep.,Oct., November 1999 Jan.,Feb.,Mar., 2000
Orientocreadium betwaensis n.sp.	Intestine	13	7	Jan.,Feb.,Aug., October 1999 Feb.,March 2000
Orientocreadium batrachoides Tubangui, 1931	Intestine	2	1	April 2000
Allocreadium handiai Pande, 1937	Intestine	15	8	November 1998 Mar.,Apr.,Oct. 1999 Feb.,Mar.,Apr. 2000
Pycnadena bariliusi V.Kumari, 1973	Stomach	1	1	January 2000

Channa punctatus (Bl.) :

From July 1998 to June 2000 , the author regularly examined fifteen fishes per month of each host species. Accordigly ***Channa punctatus*** was collected every month to procure parasites. On an average fifteen host fishes were examined per month and one hundred & eighty fishes were examined from July 1998 to June 1999 and the same number was examined from July 1999 to June 2000 (Total 360 host fishes). The number of trematodes and the month in which they were recovered were recorded. The analysis of the data has been given in (Table 2-A). This table shows that in all, ***Channa punctatus*** harboured nine trematode species including 3 metacercariae. ***Orientocreadium indicum*** was the dominant trematode species.

Channa striatus (Bl.) :

Fifteen host fishes per month were examined for a period of two years. The data collected has been analysed in Table 2-B. The analysis shows that ***C. striatus*** harboured four trematode species including one metacercaria. Prasitewise, ***O. indicum*** formed most dominant trematode species.

Channa marulius (Ham.) :

Channa marulius shows minimum trematode infestation during a study period of two years from July 1998 to June 2000 . This

species of ***Channa*** harboured only one trematode species ***O. indicum*** and one metacercaria.

H. fossilis (Bl.) :

This air-breathing host fish harboured six trematode species including one new species with maximum number of ***P. tripathi***. The new species harboured by the river : is ***O. betwaensis*** n.sp.

Clarias batrachus (Linn.) :

Most commonly available cat fish, ***Clarias batrachus***, harboured six different trematode species including a new species ***Orientocreadium betwaensis*** n.sp.

Thus the above analysis suggests that ***Channa punctatus*** (Bl.) and ***Clarias batrachus*** (Linn.) are the most susceptible host fishes for trematode infestation.

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OVERALL INCIDENCE OF TREMATODES

OVERALL INCIDENCE OF TREMATODES

Channa punctatus (Bl.)

TABLE 3-A

Parasite	No.of individuals parasitized	Parasiti-zation rate percentage	Mean No.of parasite per host
Genarchopsis singularis Srivastava, 1933	4	1.11	2.00
Genarchopsis goppo Srivastava, 1933	1	0.277	2.00
Genarchopsis piscicola Srivastava, 1933	4	1.11	2.00
Orientocreadium indicum Pande, 1934	3	0.833	3.33
Orientocreadium pseudobagri Yamaguti, 1934	3	0.833	1.33
Allocreadium handiai Pande, 1937	4	1.11	1.25
Metacercaria of ***Euclinostomum heterostomum*** (Rudolphi, 1809) Travassos, 1928	3	0.833	1 33
Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911	1	0.277	3.00
Clinostomum complanatum (Rudolphi, 1819) Braun, 1899	17	4.722	2.352

Channa striatus (Bl.)

TABLE 3-B

Parasite	No.of individuals parasitized	Parasiti-zation rate percentage	Mean No.of parasite per host
Genarchopsis singularis Srivastava, 1933	1	0.277	2.00
Orientocreadium indicum Pande, 1934	3	0.833	2.00
Allocreadium handiai Pande, 1937	2	0.55	1.5
Metacercaria of ***Isoparorchis hypselobagri*** (Billet, 1898) Odhner, 1911	1	0.277	2.00

Channa marulius (Ham.)

TABLE 3-C

Parasite	No.of individuals parasitized	Parasiti-zation rate percentage	Mean No.of parasite per host
Orientocreadium indicum			
Pande, 1934	1	0.277	3.00
Metacercaria of			
Isoparorchis hypselobagri			
(Billet, 1898) Odhner, 1911	1	0.277	2.00

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Heteropropneustes fossilis (Bl.)

TABLE 3-D

Parasite	No.of individuals parasitized	Parasiti-zation rate percentage	Mean No.of parasite per host
Orientocreadium indicum			
Pande, 1934	3	0.833	2.33
Orientocreadium pseudobagri			
Yamaguti, 1934	2	0.55	2.00
Orientocreadium betwaensis n.sp.	1	0.277	2.00
Allocreadium handiai			
Pande, 1937	1	0.277	5.00
Haplorchoides seenghali			
Dayal and Gupta, 1954	1	0.277	1.00
Phyllodistomum tripathi			
Motwani and Srivastava, 1961	5	1.38	2.4

Clarias batrachus (Linn.)

TABLE 3-E

Parasite	No.of individuals parasitized	Parasiti-zation rate percentage	Mean No.of parasite per host
Orientocreadium indicum			
Pande, 1934	21	5.83	6.047
Orientocreadium pseudobagri			
Yamaguti, 1934	8	2.22	2.125
Orientocreadium betwaensis n.sp.	7	1.94	1.857
Orientocreadium batrachoides			
Tubangui, 1931	1	0.277	2.00
Allocreadium handiai			
Pande, 1937	8	2.22	1.875
Pycnadena bariliusi			
V. Kumari, 1973	1	0.277	1.00

It is evident from the Tables 3-A to 3-E that ***O. indicum*** is the most predominant trematode parasite inhabiting all five host fishes; ***A. handiai*** - Parasitized four host sp. viz. ***C. punctatus***, ***C. striatus***, ***H. fossilis*** and ***C. batrachus***; ***O. pseudobagri*** inhabiting three host species viz. ***C. punctatus***, ***H. fossilis*** and ***C. batrachus***; ***O. mathuransis*** n.sp. parasitized two host species ***H. fossilis*** and ***Clarias batrachus*** remaining parasites inhabited single host species.

Metacarcaria of ***I. hypsolobagri*** inhabited all the three species of ***Channa*** available locally, where as other metacercaria lived in single host fish viz ***Channa punctatus***.

In this table, rate of parasitization and mean number of parasites per host has also been analysed.

Although the results analysed in Tables 3-A, 3-B, 3-C, 3-D and 3-E give overall picture of the incidence of trematode infestation found, they do not give an accurate picture of the level of parasitization at an given time of the year. Therefore in Tables 4-A, 4-B, 4-C, 4-D and in 4-E the levels of parasitization of each month of the year are given separately for the five species of host fishes.

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LEVEL AND INTENSITY OF PARASITIZATION

LEVEL AND INTENSITY OF PARASITIZATION

Channa punctatus (Bl.)

TABLE 4-A

Parasite	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
	(a) Mean % of fishes parasitized (Level of parasitization)											
Genarchopsis singularis Srivastava, 1933	3.33	3.33	-	-	-	3.33	-	-	-	3.33	-	-
Genarchopsis goppo Srivastava, 1933	-	-	-	-	-	-	-	3.33	-	-	-	-
Genarchopsis piscicola Srivastava, 1933	-	-	3.33	-	3.33	3.33	-	-	3.33	-	-	-
Orientocreadium indicum Pande, 1934	3.33	3.33	-	-	3.33	-	-	-	-	-	-	-
Orientocreadium pseudobagri Yamaguti, 1934	-	6.66	-	-	3.33	-	-	-	-	-	-	-
Allocreadium handiai Pande, 1937	3.33	-	-	-	3.33	3.33	-	-	-	3.33	-	-
Metacercaria of ***Euclinostomum heterostomum*** (Rudolphi, 1809) Travassos, 1928	6.66	-	-	-	-	-	3.33	-	-	-	-	-
Isoparorchis hypselobagri (Billet, 1928) Odhner, 1911	-	-	-	-	-	-	-	-	-	3.33	-	-
Clinostomum complanatum (Rudolphi, 1819) Braun. 1899	10.0	6.66	3.33	3.33	3.33	6.66	6.66	3.33	3.33	3.33	3.33	3.33

Parasite	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
(b) Mean number of parasites per host (Intensity of parasitization)												
Genarchopsis singularis Srivastava, 1933	2.0	2.0	-	-	-	3.0	-	-	-	1.0	-	-
Genarchopsis goppo Srivastava, 1933	-	-	-	-	-	-	-	2.0	-	-	-	-
Genarchopsis piscicola Srivastava, 1933	-	-	2.0	-	3.0	2.0	-	-	1.0	-	-	-
Orientocreadium indicum Pande, 1934	2.0	2.0	-	-	6.0	-	-	-	-	-	-	-
Orientocreadium pseudobagri Yamaguti, 1934	-	1.5	-	-	1.0	-	-	-	-	-	-	-
Allocreadium handiai Pande, 1937	2.0	-	-	-	1.0	1.0	-	-	-	1.0	-	-
Metacercaria of ***Euclinostomum heterostomum*** (Rudolphi, 1809) Travassos, 1928	1.5	-	-	-	-	-	1.0	-	-	-	-	-
Isoparorchis hypselobagri (Billet, 1928) Odhner, 1911	-	-	-	-	-	-	-	-	-	3.0	-	-
Clinostomum complanatum (Rudolphi, 1819) Braun, 1899	3.0	2.0	3.0	3.0	2.0	2.5	2.0	2.0	3 0	2.0	1.0	2.0

Channa striatus (Bl.)

TABLE 4-B

Parasite	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
	(a) Mean % of fishes parasitized (Level of parasitization)											
Genarchopsis singularis												
Srivastava, 1933	-	-	-	3.33	-	-	-	-	-	-	-	-
Orientocreadium indicum												
Pande, 1934	3.33	-	3.33	-	3.33	-	-	-	-	-	-	-
Allocreadium handiai												
Pande, 1937	-	3.33	-	-	-	-	-	-	-	3.33	-	-
Metacercaria of ***Isoparorchis hypselobagri***												
(Billet, 1928) Odhner, 1911	-	-	-	-	-	-	3.33	-	-	-	-	-

Channa striatus (Bl.)

TABLE 4-B (Continued.....)

Parasite	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
(b) Mean number of parasites per host (Intensity of parasitization)												
Genarchopsis singularis												
Srivastava, 1933	-	-	-	2.0	-	-	-	-	-	-	-	-
Orientocreadium indicum												
Pande, 1934	3.0	-	2.0	-	1.0	-	-	-	-	-	-	-
Allocreadium handial												
Pande, 1937	-	2.0	-	-	-	-	-	-	-	1.0	-	-
Metacercaria of ***Isoparorchis hypselobagri***												
(Billet, 1898) Odhner, 1911	-	-	-	-	-	-	2.0	-	-	-	-	-

Channa marulius (Ham.)

TABLE 4-C

Parasite	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
	(a) Mean % of fishes parasitized (Level of parasitization)											
Orientocreadium indicum												
Pande, 1934	-	3.3	-	-	-	-	-	-	-	-	-	-
Metacercaria of ***Isoparorchis hypselobagri***												
(Billet, 1898) Odhner, 1911	-	-	3.33	-	-	-	-	-	-	-	-	-

Channa marulius (Ham.)

TABLE 4-C (Continued.....)

Parasite	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
(b) Mean number of parasites per fish (Intensity of parasitization)												
Orientocreadium indicum												
Pande, 1934	-	3.0	-	-	-	-	-	-	-	-	-	-
Metacercaria of ***Isoparorchis hypselobagri***												
(Billet, 1898) Odhner, 1911	-	-	2.0	-	-	-	-	-	-	-	-	-

Heteropneustes fossilis (Bl.)

TABLE 4-D

Parasite	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
	(a) Mean % of fishes parasitized (Level of parasitization)											
Orientocreadium indicum Pande, 1934	3.33	-	-	-	3.33	-	-	-	3.33	-	-	-
Orientocreadium pseudobagri Yamaguti, 1934	-	-	-	-	-	-	-	6.66	-	-	-	-
Orientocreadium mathuransis n.sp.	-	-	-	-	-	-	3.33	-	-	-	-	-
Allocreadium handiai Pande, 1937	-	-	-	-	-	-	-	3.33	-	-	-	-
Haplorchoides seenghali Dayal & Gupta, 1954	-	-	-	-	-	-	-	3.33	-	-	-	-
Phyllodistomum tripathi Motwani & Srivastava 1961	6.66	10.0	-	-	-	-	-	-	-	-	-	-

Heteropneustes fossilis (Bl.)

TABLE 4-D (Continued.....)

Parasite	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
(b) Mean number of parasites per fish (Intensity of parasitization)												
Orientocreadium indicum Pande, 1934	2.0	-	-	-	2.0	-	-	-	2.0	-	-	-
Orientocreadium pseudobagri Yamaguti, 1934	-	-	-	-	-	-	-	2.0	-	-	-	-
Orientocreadium betwaensis n.sp.	-	-	-	-	-	-	2.0	-	-	-	-	-
Allocreadium handiai Pande, 1937	-	-	-	-	-	-	-	5.0	-	-	-	-
Haplorchoides seenghali Dayal & Gupta, 1954	-	-	-	-	-	-	-	1.0	-	-	-	-
Phyllodistomum tripathi Motwani & Srivastava 1961	2.5	2.33	-	-	-	-	-	-	-	-	-	-

Clarias batrachus (Linn.)

TABLE 4-E

Parasite	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
	(a) Mean % of fishes parasitized (Level of parasitization)											
Orientocreadium indicum Pande, 1934	-	6.66	6.66	6.66	3.33	10.0	10.0	6.66	6.66	3.33	-	-
Orientocreadium pseudobagri Yamaguti, 1934	-	3.33	6.66	3.33	3.33	-	3.33	3.33	3.33	-	-	-
Orientocreadium betwaensis n.sp.	-	6.66	-	-	-	-	3.33	6.66	3.33	-	-	-
Orientocreadium batrachoides Tabungui, 1931	-	-	-	-	-	-	-	-	-	3.33	-	-
Allocreadium handiai Pande, 1937	-	-	-	3.33	3.33	-	-	6.66	6.66	6.66	-	-
Pycnadena barilliusi Kumari, 1973	-	-	-	-	-	-	3.33	-	-	-	-	-

Clarias batrachus (Linn.)

TABLE 4-E (Continued.....)

Parasite	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
(b) Mean number of parasites per fish (Intensity of parasitization)												
Orientocreadium indicum Pande, 1934	-	8.0	7.5	7.5	8.0	4.33	8.33	3.0	1.5	2.0	-	-
Orientocreadium pseudobagri Yamaguti, 1934	-	3.0	2.5	3.0	2.0	-	2.0	1.0	1.0	-	-	-
Orientocreadium mathuransis n.sp.	-	2.0	-	2.0	-	-	1.0	1.0	4.0	-	-	-
Orientocreadium batrachoides Tabungui, 1931	-	-	-	-	-	-	-	-	-	2.0	-	-
Allocreadium handiai Pande, 1937	-	-	-	1.0	1.0	-	-	2.5	2.0	2.0	-	-
Pycnadena bariliusi Kumari, 1973	-	-	-	-	-	-	1.0	-	-	-	-	-

The analysis of the above Tables (4-A, 4-B, 4-C & 4-E) shows that in ***Channa punctatus*** (Table 4-A) the highest incidence of parasitization by ***G. singularis*** is found uniformaly in the month of July, August, December and April; by ***G. piscicola*** the highest incidence of parasitization in September, November, December and March; ***Allocreadium handiai*** had the highest incidence of parasitization in July, November, December and April, and ***Clinostomum complanatum*** metacercariae were found uniformly in all months of July and minimum level of parasitization during the months of September, October, November, February, March, April, May and June.

In ***Channa striatus*** (Table 4-B) the highest incidence of parasitization is found uniformly by ***O. indicum*** in the month of July, September and November.

In ***Channa marulius*** (Table 4-C) the incidence of parasitization by ***O. indicum*** is found in the month of August, by ***Isoparorchis hypselobagri*** (metacercaria) the incidence is found in the month of September.

In ***H. fossilis*** (Table 4-D) the highest incidence of parasitization by ***P. tripathi*** was found in the month of August and lowest in July.

In ***Clarias batrachus*** (Table 4-E) the highest incidence of parasitization by ***O. indicum*** was found in the month of August and lowest in November and April.

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SEASONAL INCIDENCE OF PARASITES

SEASONAL INCIDENCE OF PARASITES

Channa punctatus (Bl.)

TABLE 5-A

Parasites	Winter season (N D J F)		Summer season (M A M J)		Rainy season (J A S O)	
	(a)	(b)	(a)	(b)	(a)	(b)
Genarchopsis singularis Srivastava, 1933	0.8325	0.750	0.8325	0.25	1.665	1.00
Genarchopsis goppo Srivastava, 1933	0.8325	0.5	-	-	-	-
Genarchopsis piscicola Srivastava, 1933	1.665	1.25	0.8325	0.25	0.8325	0.50
Orientocreadium indicum Pande, 1934	0.8325	1.5	-	-	1.665	1.00
Orientocreadium pseudobagri yamaguti, 1934	0.8325	0.25	-	-	1.665	0.375
Allocreadium handiai Pande, 1937	1.665	0.5	0.8325	0.25	0.8325	0.50
Metacercaria of ***Euclinostomum heterostomum*** (Rudolphi, 1809) Travassos, 1928	0.8325	0.25	-	-	1.665	0.375
Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911	-	-	0.8325	0.75	-	-
Clinostomum complanatum (Rudolphi, 1819) Braun, 1899	4.995	2.125	3.3300	2.0	5.830	2.75

(a) = % of hosts parasitized. (b) = Mean number of parasites per host

Channa striatus (Bl.)

TABLE 5-B

Parasites	Winter season (N D J F)		Summer season (M A M J)		Rainy season (J A S O)	
	(a)	(b)	(a)	(b)	(a)	(b)
Genarchopsis singularis Srivastava, 1933	-	-	-	-	0.8325	0.5
Orientocreadium indicum Pande, 1934	0.8325	0.25	-	-	0.8325	1.25
Allocreadium handiai Pande, 1937	-	-	0.8325	0.25	0.8325	0.5
Metacercaria of ***Isoparorchis hypselobagri*** (Billet, 1898) Odhner, 1911	0.8325	0.5	-	-	-	-

(a) = % of hosts parasitized, (b) = Mean number of parasites per host

Channa marulius (Ham.)

TABLE 5-C

Parasites	Winter season (N D J F)		Summer season (M A M J)		Rainy season (J A S O)	
	(a)	(b)	(a)	(b)	(a)	(b)
Orientocreadium indicum Pande, 1934	-	-	-	-	0.8325	0.75
Metacercaria of ***Isoparorchis hypselobagri*** (Billet, 1898) Odhner, 1911	-	-	-	-	0.8325	0.5

(a) = % of hosts parasitized, (b) = Mean number of parasites per host

Channa striatus (Bl.)

TABLE 5-D

Parasites	Winter season (N D J F)		Summer season (M A M J)		Rainy season (J A S O)	
	(a)	(b)	(a)	(b)	(a)	(b)
Orientocreadium indicum Pande, 1934	0.8325	0.25	0.8325	0.75	0.8325	0.5
Orientocreadium pseudobagri Yamaguti, 1934	1.665	0.5	-	-	-	-
Orientocreadium betwaensis n.sp.	0.8325	0.5	-	-	-	-
Allocreadium handiai Pande, 1937	0.8325	1.25	-	-	-	-
Haplorcholdes seenghali Dayal and Gupta, 1954	0.8325	0.25	-	-	-	-
Phyliodistomum tripathi Motwani and Srivastava, 1961	-	-	-	-	4.165	1.275

(a) = % of hosts parasitized, (b) = Mean number of parasites per host

Clarias batrachus (Linn.)

TABLE 5-E

Parasites	Winter season (N D J F)		Summer season (M A M J)		Rainy season (J A S O)	
	(a)	(b)	(a)	(b)	(a)	(b)
Orientocreadium indicum Pande, 1934	7.4975	5.915	2.4975	0.875	7.495	5.75
Orientocreadium pseudobagri Yamaguti, 1934	2.4975	1.25	0.8325	0.25	3.33	2.125
Orientocreadium mathuransis n.sp.	2.4975	0.5	0.8325	1.0	2.4975	1.0
Orientocreadium batrachoides Tabungui, 1931	-	-	0.8325	0.5	-	-
Allocreadium handiai Pande, 1937	2.4975	0.875	3.33	1.0	0.8325	0.25
Pycnadena bariliusi V. Kumari, 1973	0.8325	0.25	-	-	-	-

(a) = % of hosts parasitized, (b) = Mean number of parasites per host

It is clear from the Table 5-A that in ***Channa punctatus*** the maximum infestation is recorded during winter season. The highest percentage of the fish, ***Channa punctatus*** parasitized by ***G. sigularis*** and the highest mean number of parasites per host are in rainy season. The highest percentage of hosts parasitized by ***G. piscicola*** and the highest mean number of parasites per host occured during winter season. The highest percentage of hosts parasitized by ***A. handiai*** occurred in winter and highest mean number of parasites per host in rainy and winter season. The highest percentage of the fish, ***Channa punctatus*** parasitized by ***Clinostomum complanatum*** (metacercaria) and the highest mean number of parasites per host occured during rainy season.

In ***Channa striatus*** (Table 5-B) the maximum number of parasites were recorded in rainy season. The highest percentage of hosts parasitized by ***O. indicum*** occured during winter and rainy season and the highest mean number of parasites per host during rainy season. The highest percentage of host parasitized by ***A. handiai*** occurred in summer and rainy season and highest mean number of parasites per host in rainy season.

In ***Channa marulius*** (Table 5-C) the maximum number of parasites were recorded in rainy season. The high percentage of the fish ***Channa marulius*** parasitized by ***O. indicum*** and the highest

mean number of parasites per host are recorded in rainy season. The highest percentage of the fish, ***Channa marulius*** parasitized was by ***Isoparorchis hypselobagri*** (metacercaria) and the highest mean number of parasites per host are recorded in rainy season.

In ***H. fossilis*** (Table 5-D) the maximum number of parasites were recorded during winter season. The high percentage of hosts parasitized by ***O. indicum*** occurred during winter, summer and rainy season and the highest mean number of parasites per host during summer season.

In ***Clarias batrachus*** (Table 5-E) the maximum number of trematodes have been recorded during the winter season. The highest percentage of fishes parasitized by ***O. indicum*** and the highest mean number of parasites per host occurred during winter season. The highest percentage of this fish-host parasitized by ***O. pseudobagri*** and the highest mean number of parasites per host occured during rainy season. The highest percentage of fishes parasitized by ***O. betwaensis*** n.sp. occured during winter and rainy season and highest mean number of parasites per host in summer and rainy season. The highest percentage of fishes parasitized by ***A. handiai*** and the highest mean number of parasites per host occured during summer season.

It is clear from the study of above Tables (Table 5-A, 5-B, 5-C, 5-D and 5-E) that seasonal incidence of parasites was higher in all host fishes during rainy season. Out of five host fishes, ***C. batrachus***, ***C. punctatus***, ***C. striatus*** and ***Heteropneustes fossilis*** have infection in all seasons, while the least infected host fish ***C. marulius*** (Ham.) was found infected only during rainy season. Thus seasonal prevalance forms one of the major ecological factor influencing the incidence of helminth infection in host fishes.

EXPLANATION OF LIST AND TABLES

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EPLANATION OF PLATES AND FIGURES

PLATE 1

Fig. 1 ***Pycnadena bariliusi*** Kumari, 1973
(Ventral view)

PLATE 2

Fig. 2 ***Allocreadium handiai*** Pande, 1937
(Ventral view)

PLATE 3

Fig. 3 ***Orientocreadium batrachoides*** Tubangui, 1931
(Ventral view)

PLATE 4

Fig. 4 ***Orientocreadium indicum*** Pande, 1934
(Ventral view)

PLATE 5

Fig. 5 ***Orientocreadium pseudobagri*** Yamaguti, 1934
(Ventral view)

PLATE 6

Fig. 6 ***Orientocreadium betwaensis*** n.sp.
(Ventral view)

PLATE 7

Fig. 7 ***Phyllodistomum tripathi*** Motwani & Srivastava, 1961
(Ventral view)

PLATE 8
Fig. 8 Metacercaria of ***Isoparorchis hypselobagri*** (Billet, 1898) Odhner, 1911 (Ventral view)

PLATE 9
Fig. 9 ***Genarchopsis piscicola*** Srivastava, 1933 (Ventral view)

PLATE 10
Fig. 10 ***Genarchopsis goppo*** Srivastava, 1933 (Ventral view)

PLATE 11
Fig. 11 ***Genarchopsis singularis*** Srivastava, 1933 (Ventral view)

PLATE 12
Fig. 12 Metacercaria of ***Euclinostomum heterostomum*** (Rudolphi, 1809) Travassos, 1928 (Ventral view)

PLATE 13
Fig. 13 ***Haplorchoides seenghali*** Dayal and Gupta. 1954 (Ventral view)

PLATE 14
Fig. 14 Graph showing the ***helminth*** infection (Trematoes) in the fishes

PLATE 15
Fig. 15 Histogram showing the overall incidence of Trematodes in the fish, ***Channa punctatus*** (Bl.)

PLATE 16

Fig. 16 Histogram showing the overall incidence of Trematodes in the fish, ***Channa striatus*** (Bl.)

PLATE 17

Fig. 17 Histogram showing the overall incidence of Trematodes in the fish, ***Channa marulius*** (Ham.)

PLATE 18

Fig. 18 Histogram showing the incidence of five species of the Trematodes in the fishes, ***Heteropneustes fossilis*** (Bl.)

PLATE 19

Fig. 19 Histogram showing the overall incidence of six species of the Trematodes in the fish, ***Clarias batrachua*** (Linn.)

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PLATE 1.

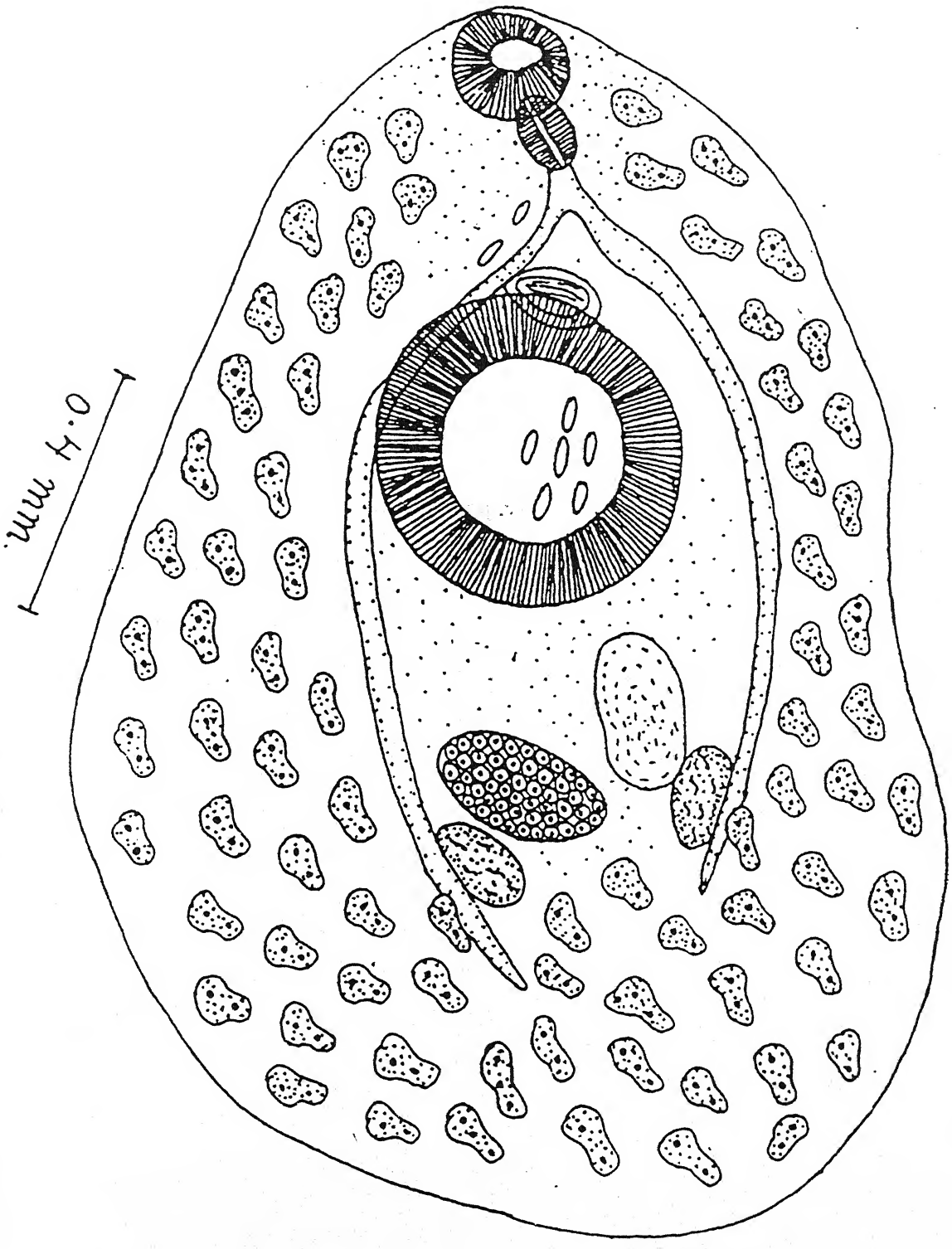


Fig. 1.

Pycnadena bariliusi Kumari, 1973; Ventral view.

PLATE 2.

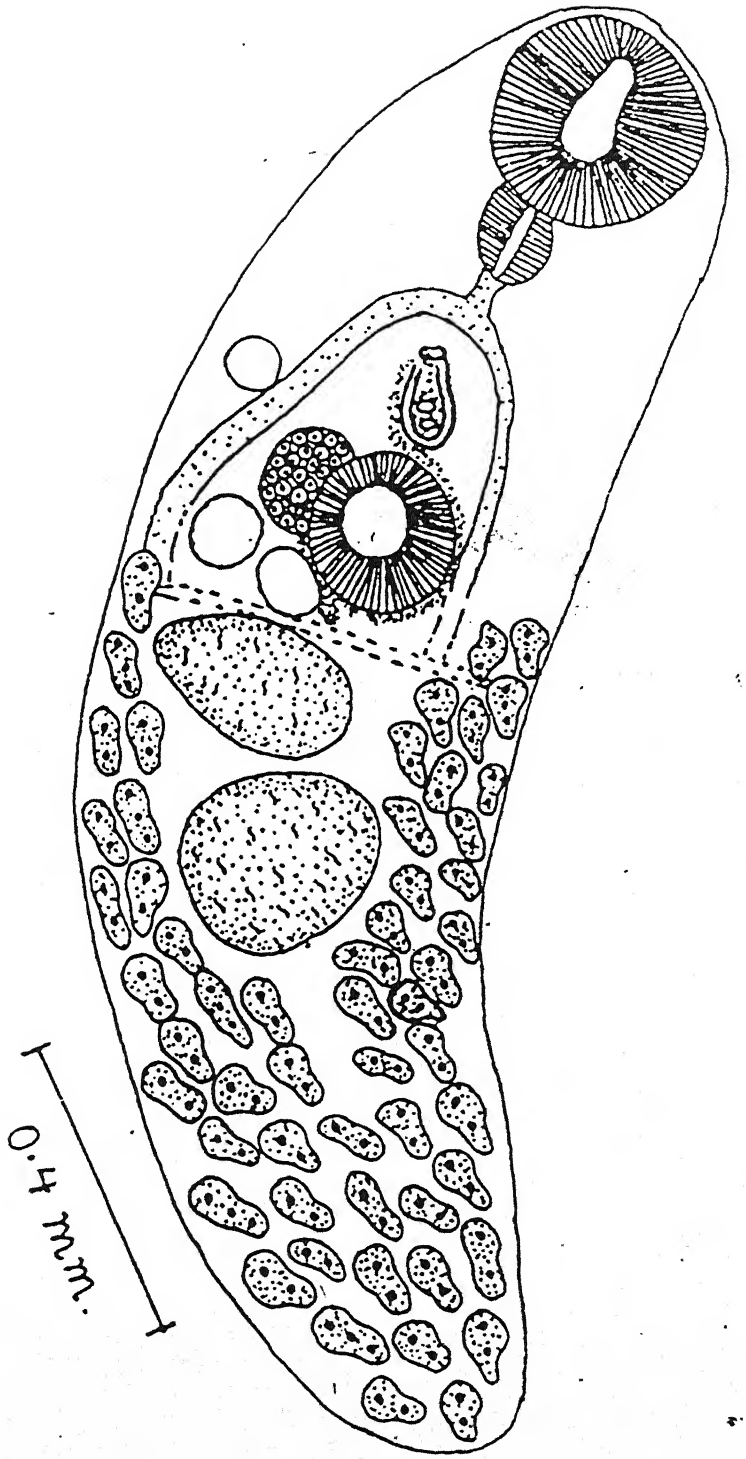


Fig. 2.

Allocreadium handiai Pande, 1937; Ventral view.

PLATE 3.

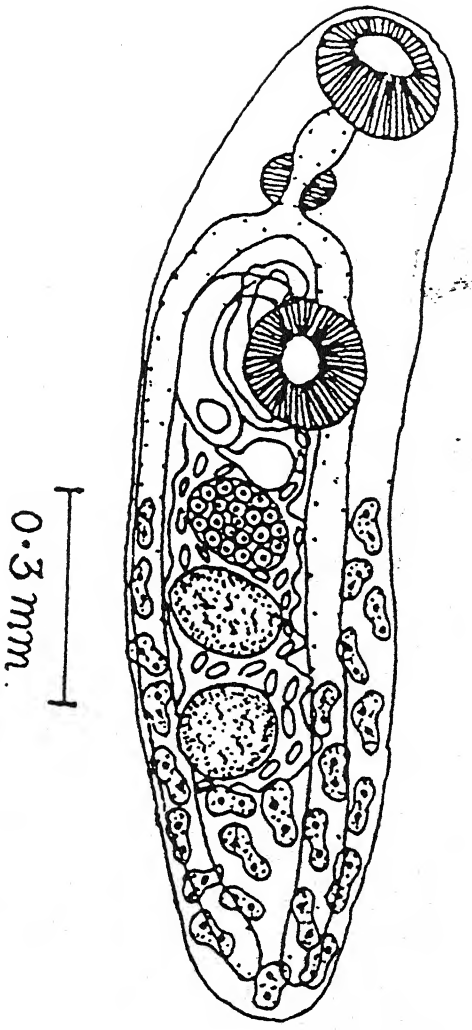


Fig. 3.

Orientocreadium batrachoides Tubangui, 1931; Ventral view

PLATE 4.

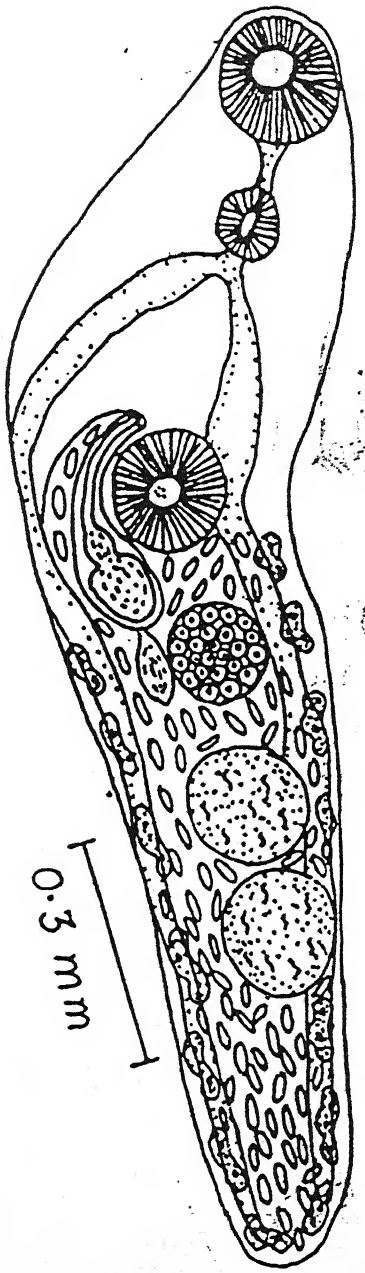


Fig. 4.

Orientocreadium indicum Pande, 1934; Ventral view

PLATE 5.

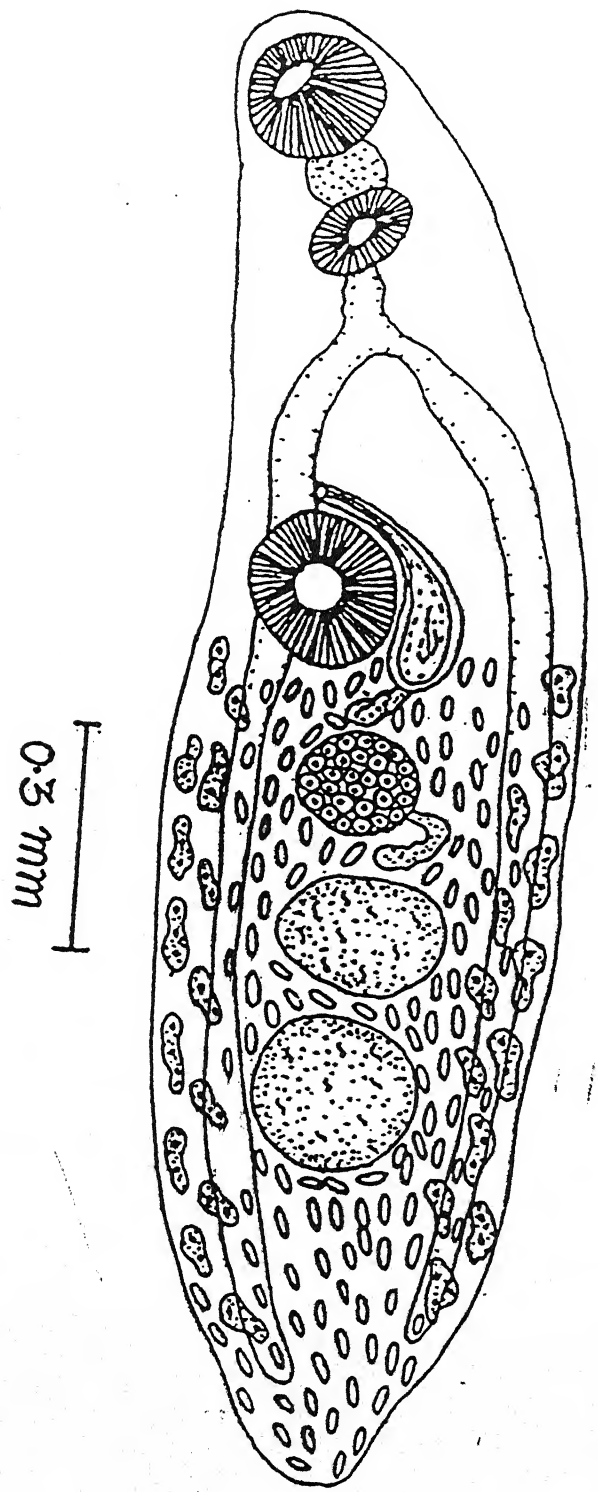


Fig. 5.

Orientocreadium pseudobagri Yamaguti, 1934; Ventral view

PLATE 6.

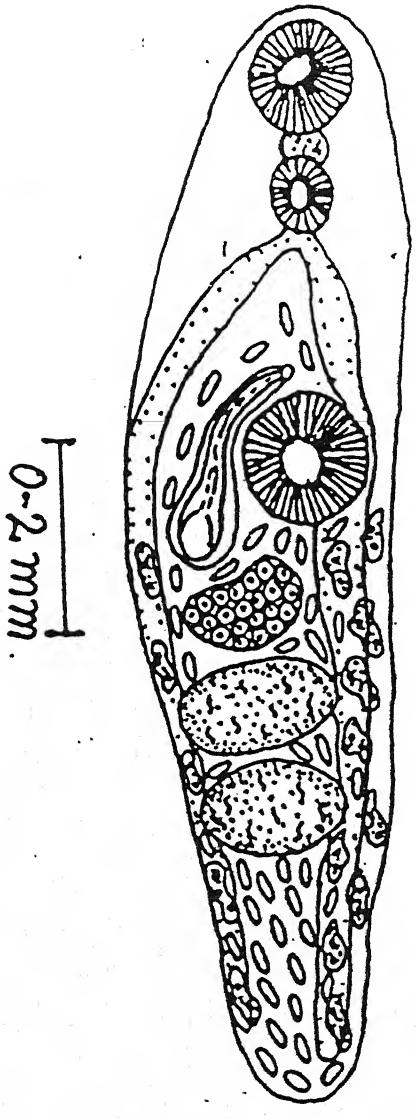


Fig. 6

Orientocreadium betwaensis n.sp.

Ventral view.

PLATE 7.

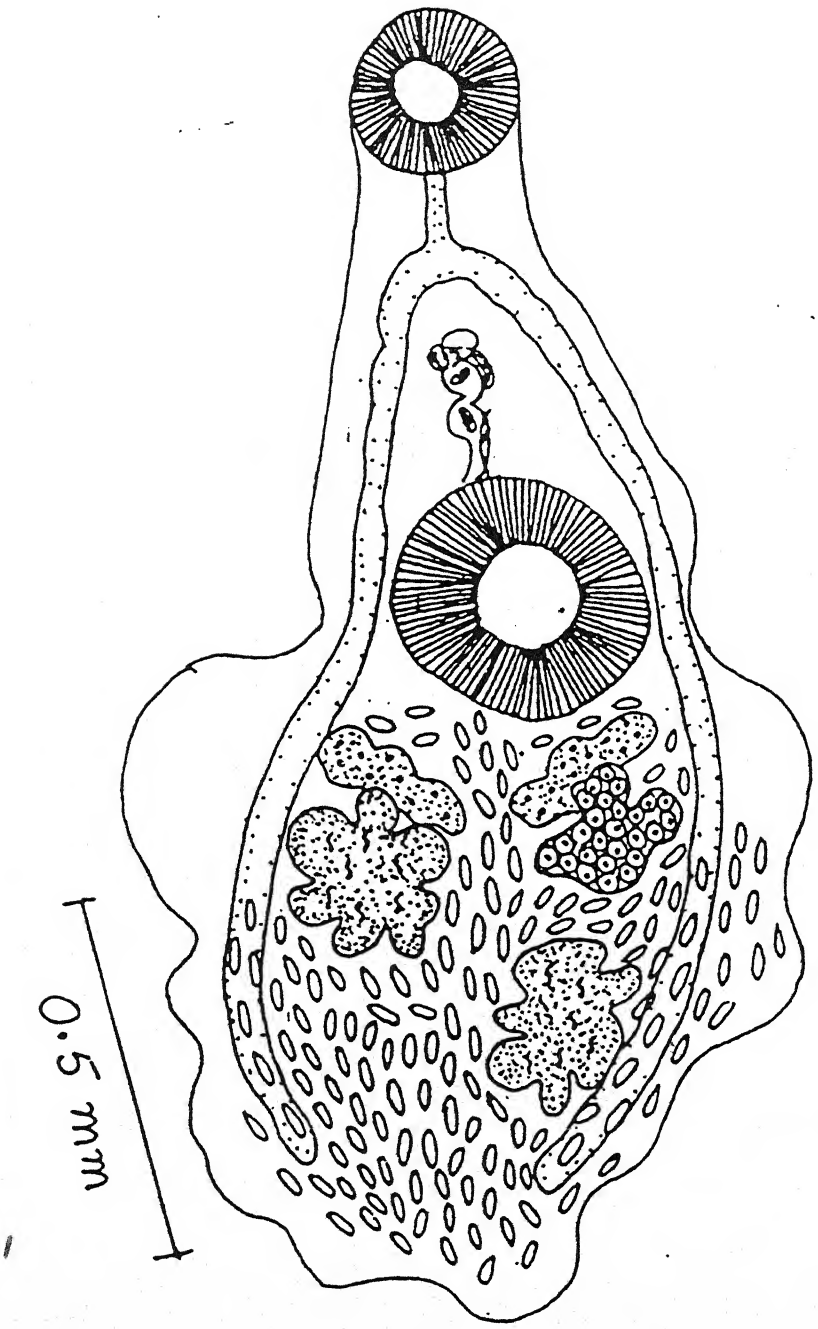


Fig. 7.

Phyllodistomun tripathi Motvani and Srivastava, 1961; Ventral view.

PLATE 8.

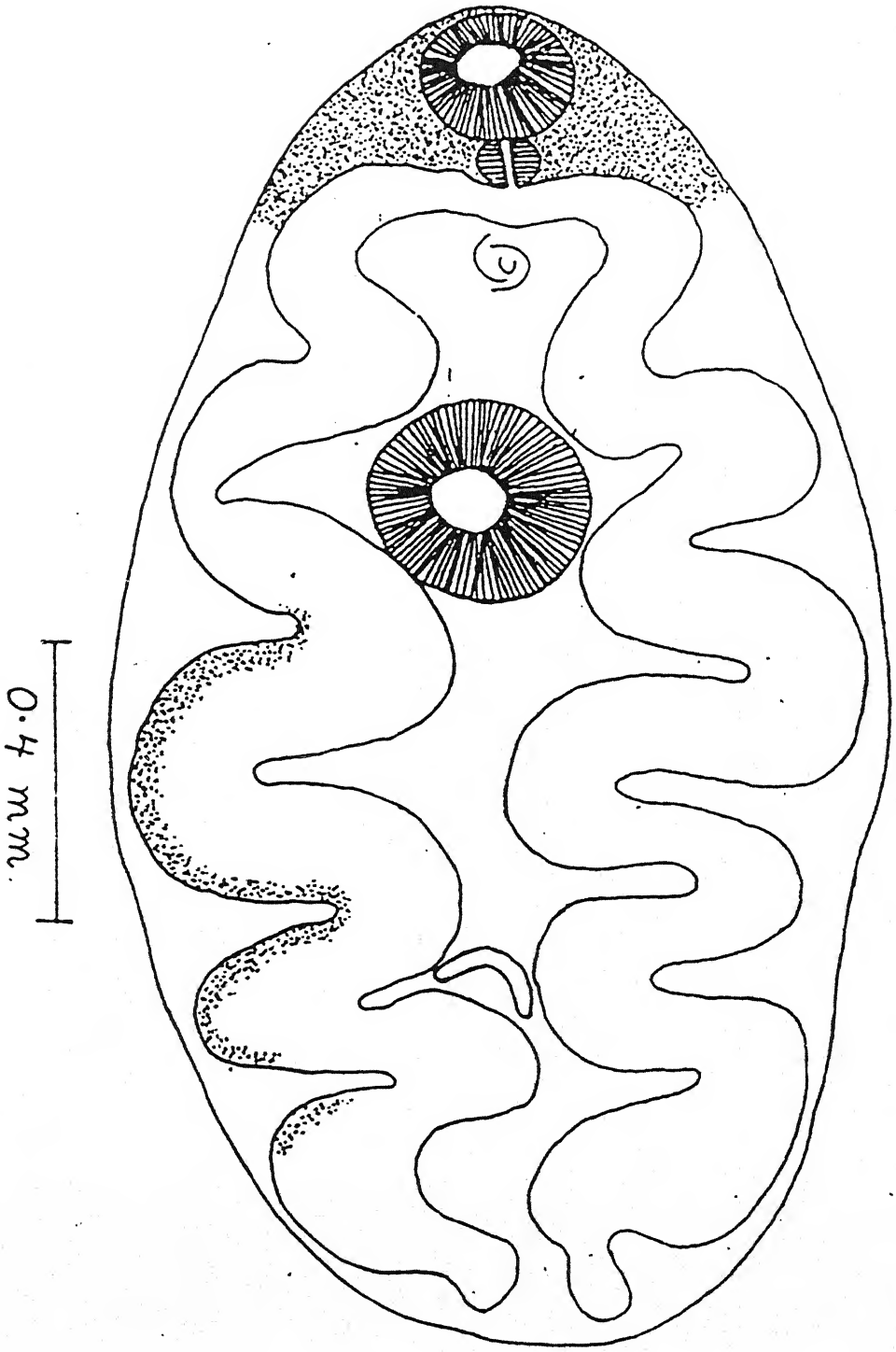


Fig. 8.

Metacercaria of Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911; Ventral view.

PLATE 9.

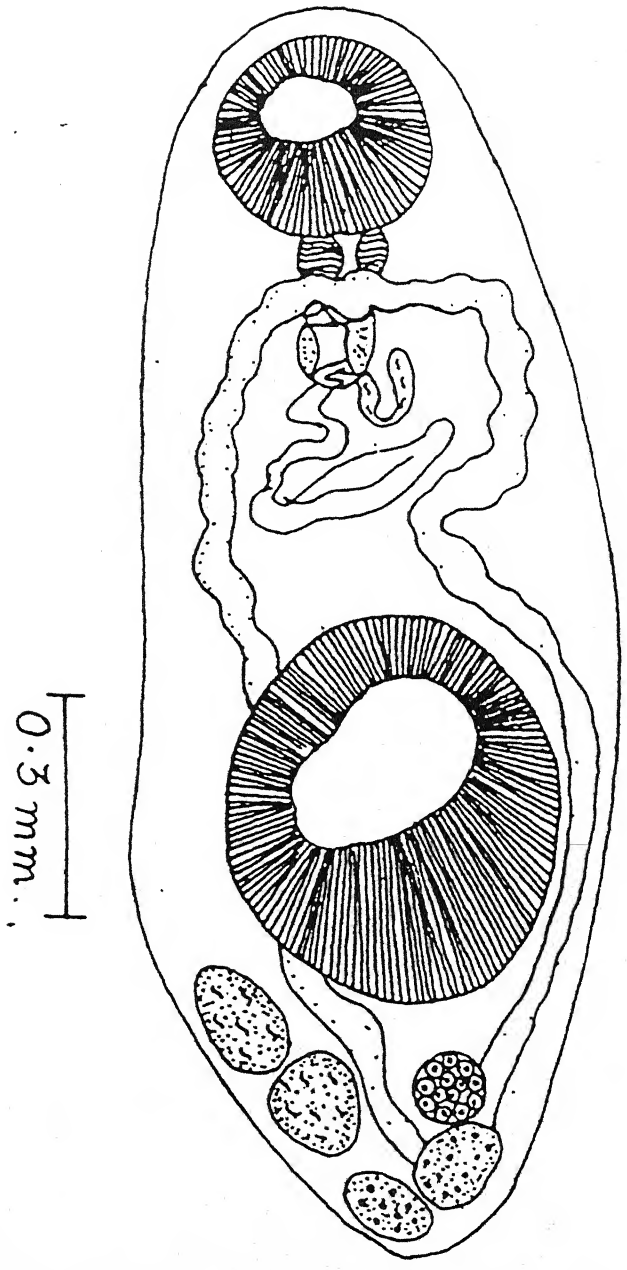


Fig. 9.

Genarchopsis piscicola Srivastava, 1933; Ventral view.

PLATE 10.

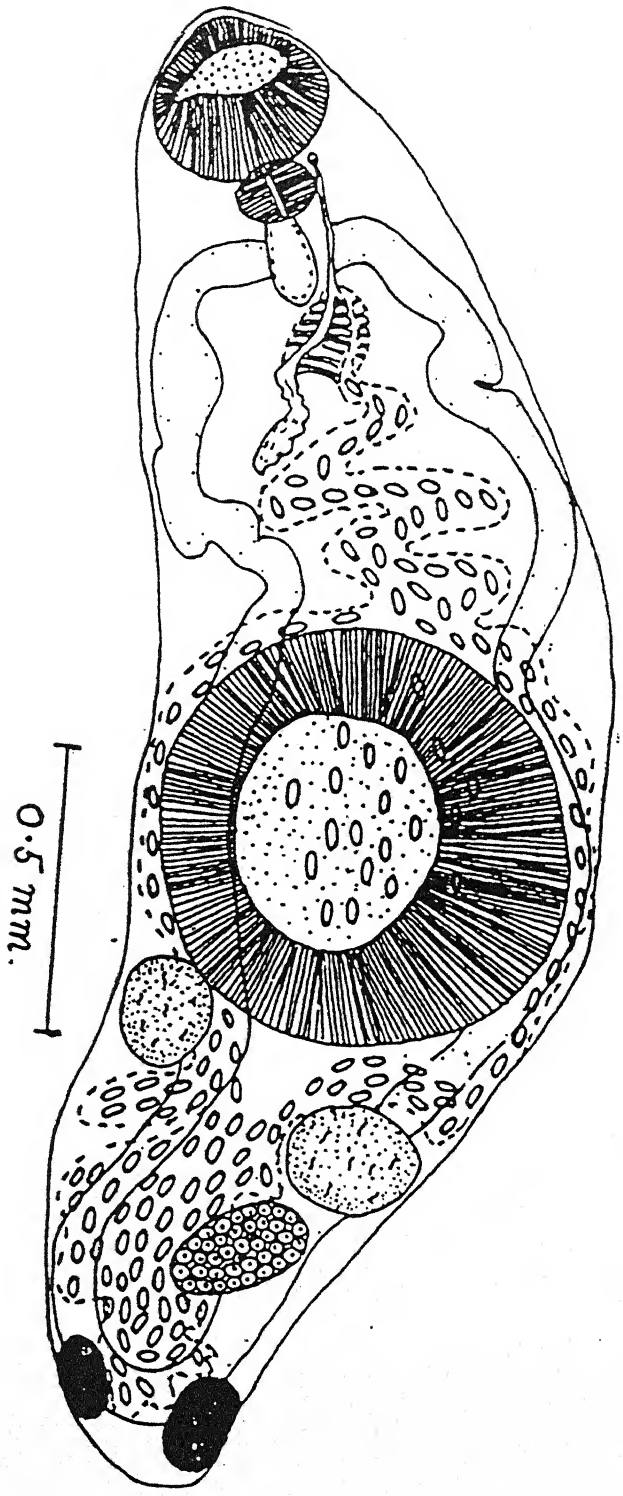


Fig. 10.

Genarchopsis goppo Srivastava, 1933; Ventral view.

PLATE 11.

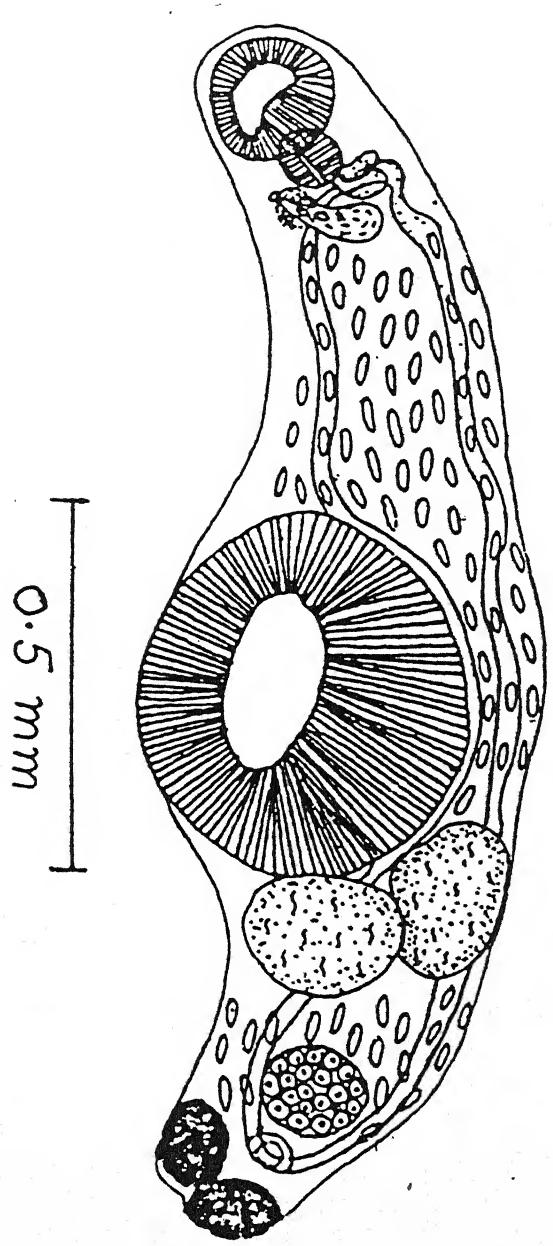


Fig. 11.

Genarchopsis singularis Srivastava, 1933; Ventral view

PLATE 12

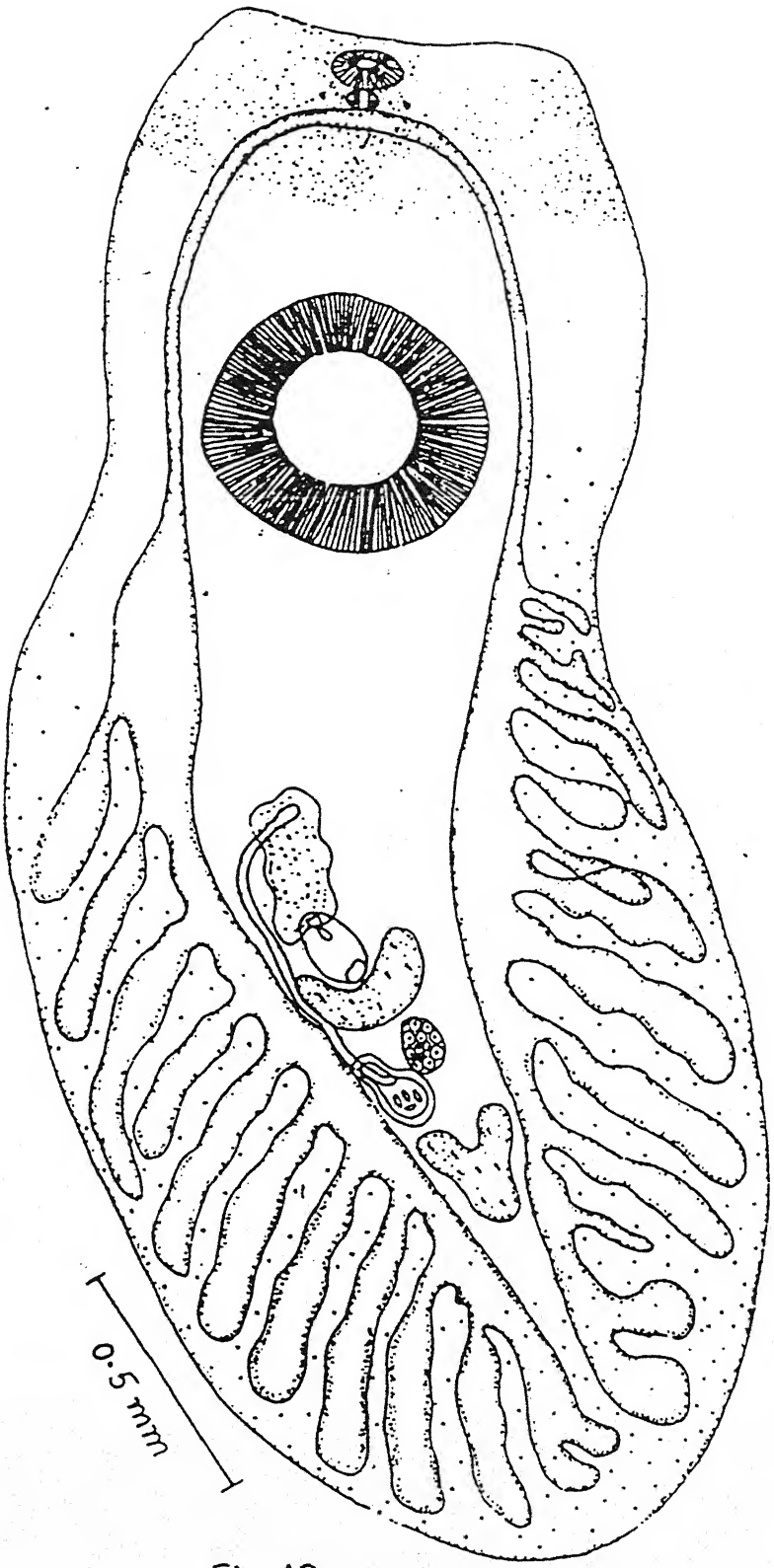


Fig. 12

Metacercaria of Euclinostomum heterostomum (Rudolphi, 1809) Travassos, 1928; Ventral view.

PLATE 13.

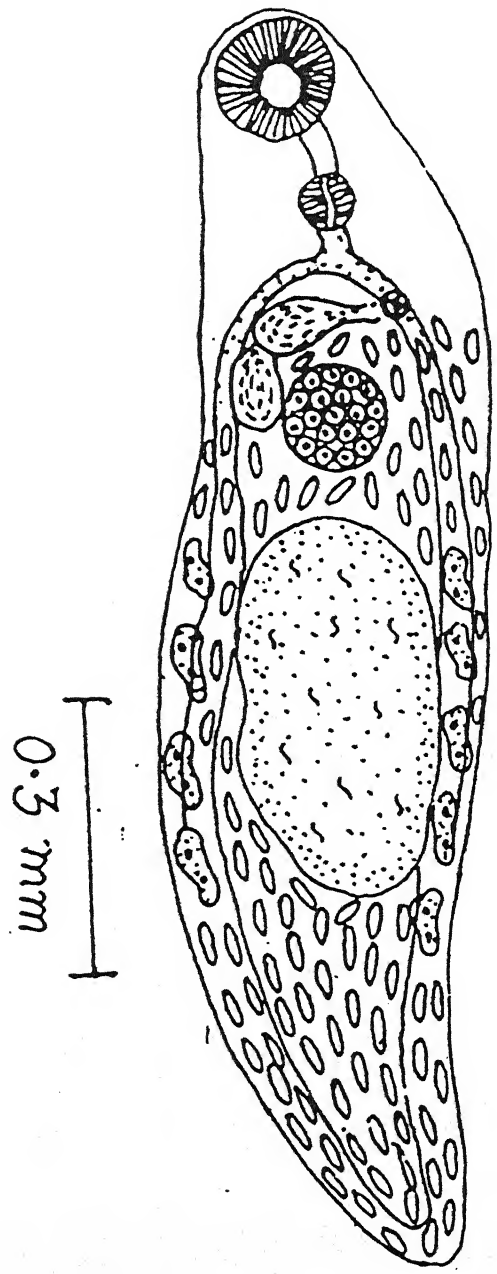


Fig. 13

Haplorchoides seenghali Dayal and Gupta, 1954
Ventral View.

PLATE 14

INDEX OF HELMINTH INFECTION (TREMATODES)

July 1998 to June 2000

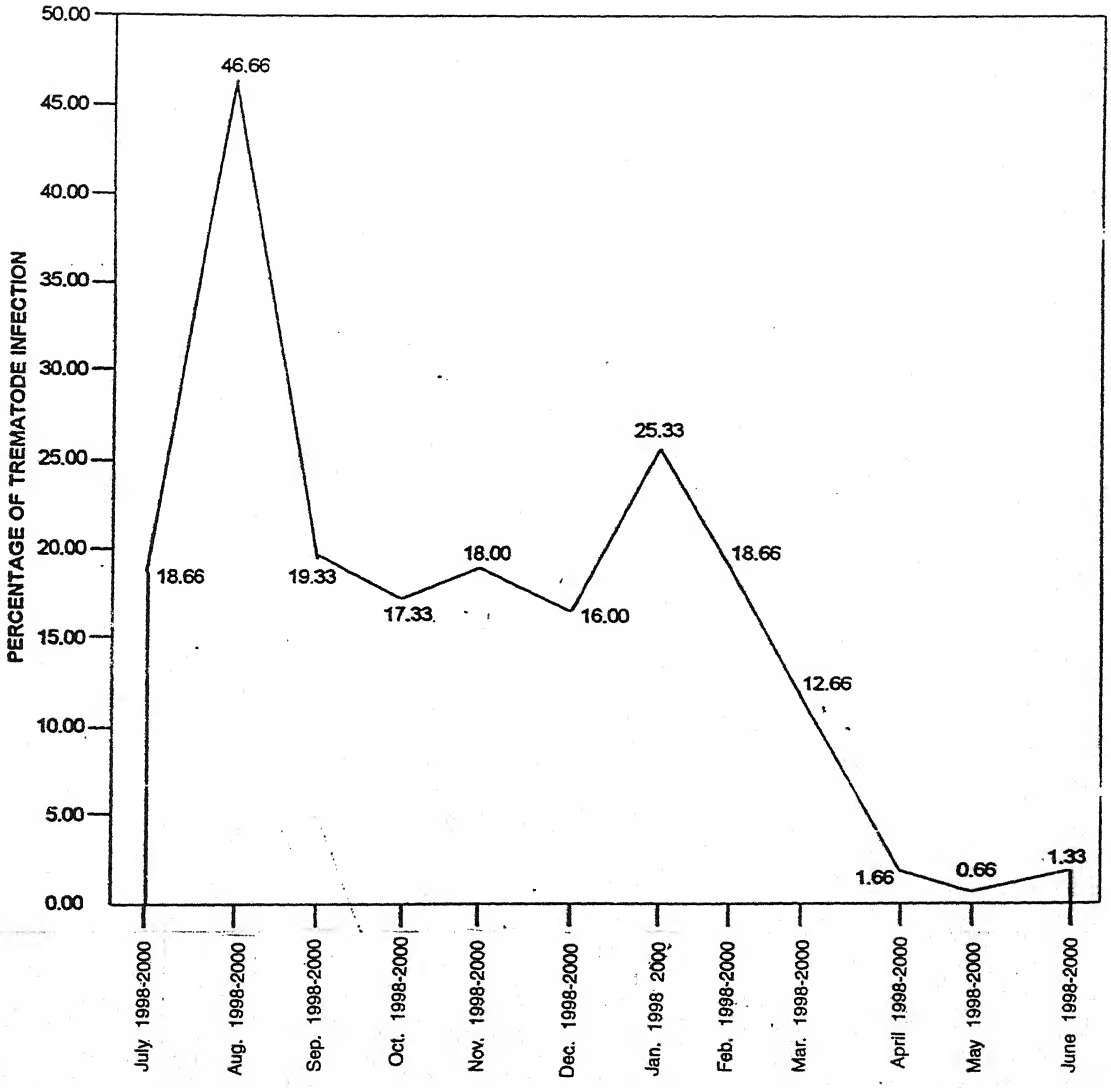
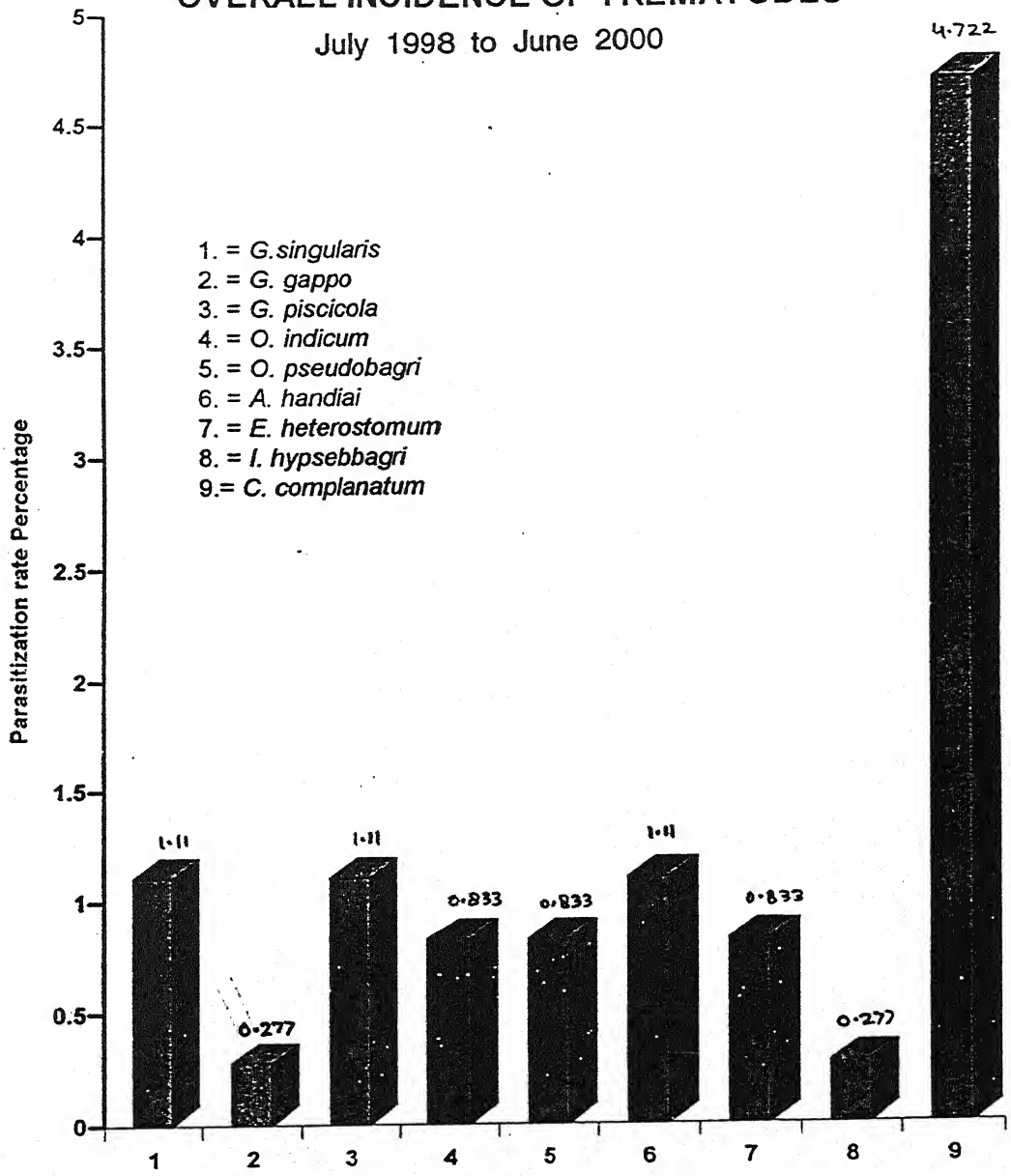


Fig. 14

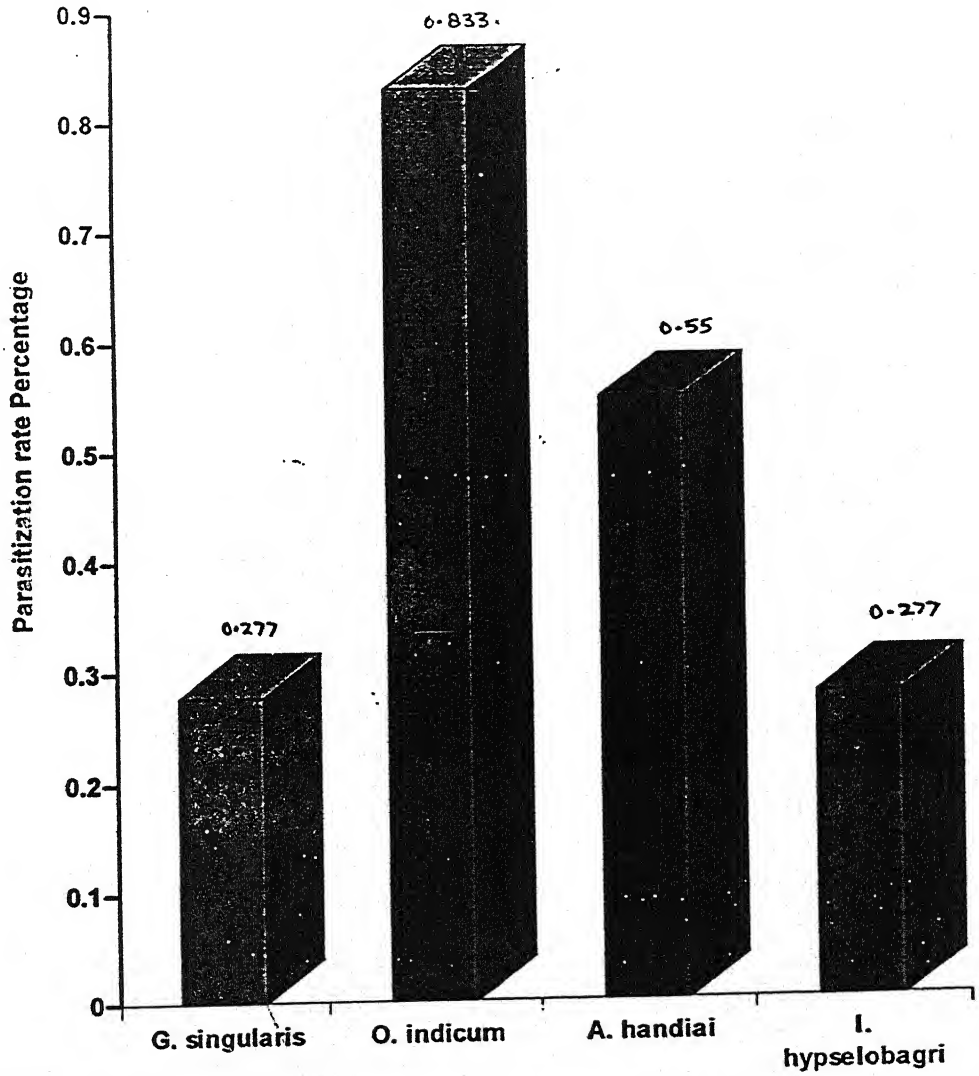
PLATE 15
OVERALL INCIDENCE OF TREMATODES
July 1998 to June 2000



In *Channa punctatus* (Bl.)

FIG. 15

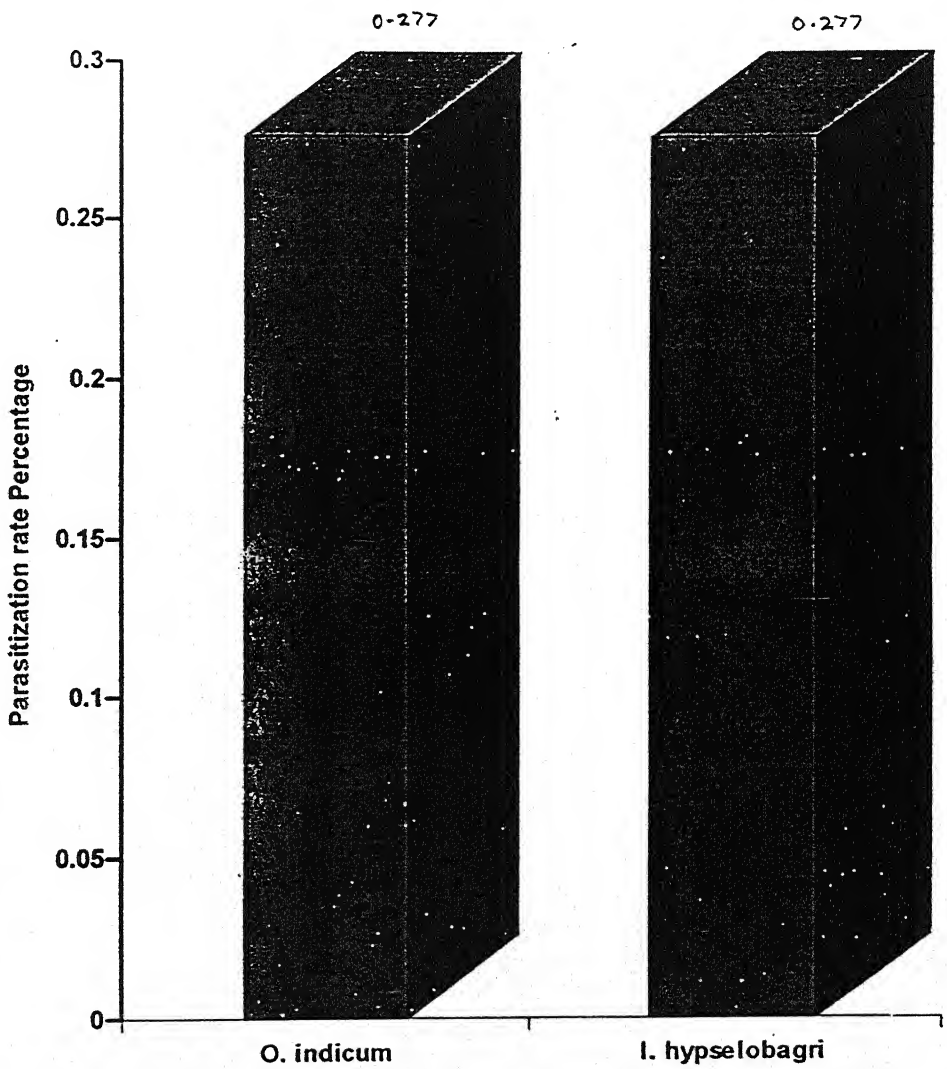
PLATE 16
OVERALL INCIDENCE OF TREMATODES
July 1998 to June 2000



In *Channa striatus* (Bl.)

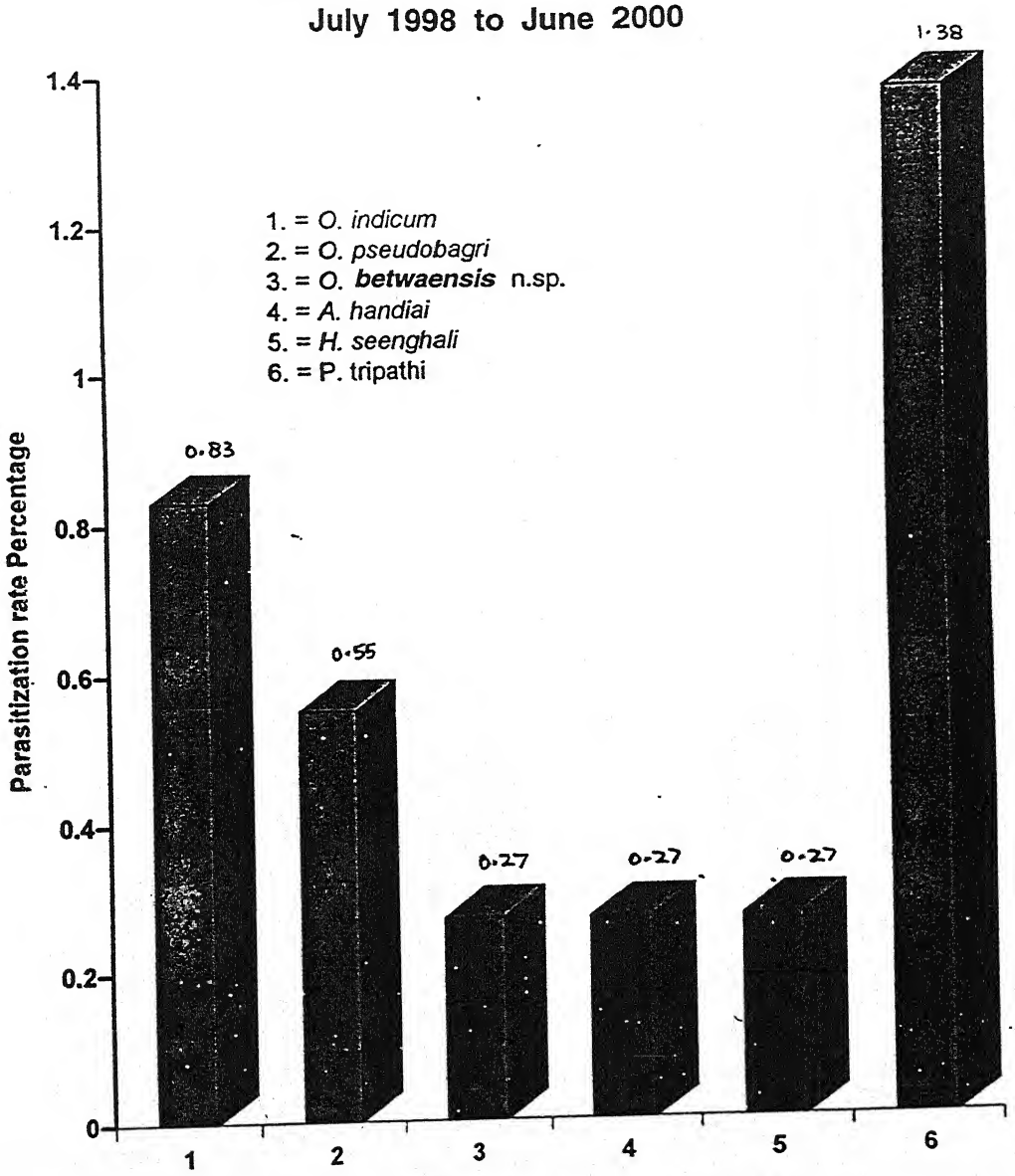
FIG. 16

PLATE 17
OVERALL INCIDENCE OF TREMATODES
July 1998 to June 2000



In *Channa marulius* (Ham.)

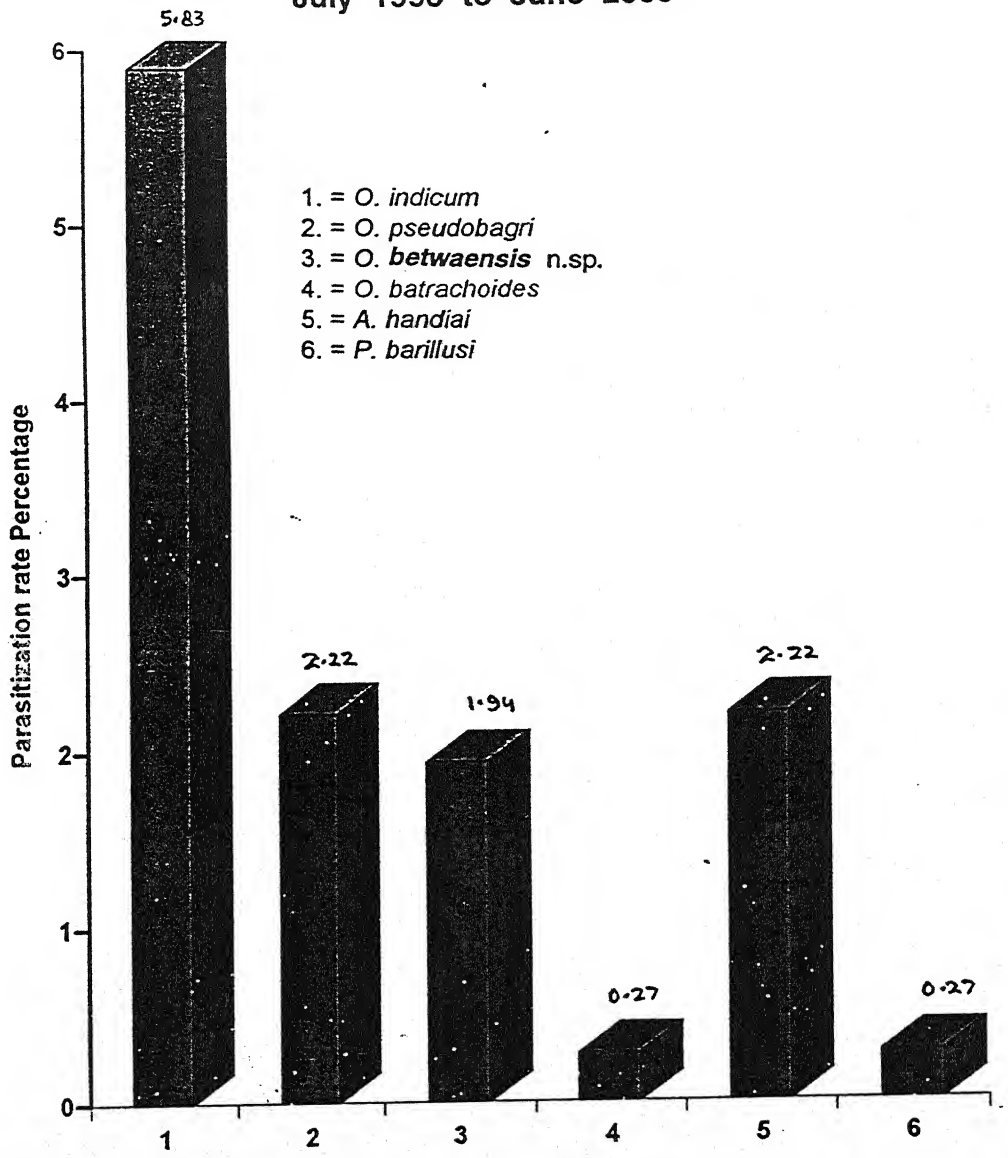
PLATE 18
OVERALL INCIDENCE OF TREMATODES
July 1998 to June 2000



In *Heteropneustes fossilis* (Bl.)

FIG. 18

PLATE 19
OVERALL INCIDENCE OF TREMATODES
July 1998 to June 2000



In *Clarias batrachus* (Linn.)

FIG. 19

SUMMARY

SUMMARY

To investigate helminth fauna from some fresh water fishes of Bundelkhand region , the author under the present project has planned to examine five host species of fresh-water air-breathing fishes, most commonly available in this region. These fishes include ***Clarias batrachus*** (Linn.); ***H. fossilis*** (Bl.) and ***Channa*** sp. namely ***Channa punctatus*** (Bl.), ***Channa striatus*** (Bl.) and ***Channa marulius*** (Ham.). Out of five species of ***Channa*** available from Uttar Pradesh viz - ***Channa gachua*** (Ham.); ***Channa leucopunctatus*** (Bl.); ***Channa striatus*** (Bl.); ***Channa punctatus*** (Bl.) and ***Channa marulius*** (Ham.) only above mentioned three species were available from water bodies of District Jhansi. (U.P.), including Jhansi city hence they have been included in the present study. These fishes were collected regularly from the rivers Betwa and Ken , ponds of several prominent places of the region for fish collection and other fresh water bodies in District Jhansi. and from local fish markets for a period of two years from July 1998 to June 2000. On an average fifteen fishes of each species (Total 75 fishes per month) were collected, examined and dissected. A total of 1800 fishes were examined during a period of two years. A thorough search was done to collect the parasites from various organs of fishes.

Soon after collection the trematodes were studied alive to observe spines or papillae if any, excretory system and genital opening. They were then fixed in 5-10% formaline, after fixation and thorough washing in water, worms were dehydrated in alcoholic series, then stained in borax carmine, cleared in xylene and finally mounted in DPX.

For preparing whole mounts of trematodes, the worms were relaxed in fresh water for some time. The body was gently stretched by adding luke warm water. Specimens were kept in 5-10% formaline overnight, then washed with water, kept in alcoholic series, stained in aceticalum carmine, cleared in clove oil and finally mounted in canada balsum or DPX.

The work incorported in the present thesis is divided into three parts.

Part I deals with introduction, historical resume, material and method, a systematic list of host examined, host-parasite list and parasite-host list.

Part II deals with the taxonomic grouping of thirteen trematodes including three metacercarial forms recovered during the study period. Mention has not been made of nematodes or cestodes as these were not the part of project. Out of these trematode species, one species has been described as new species whereas remaining ten

are redescribed in detail, furnishing further information and observations which were essential to enrich our knowledge on these parasites. They are known forms but majority of these form the first host and locality record. These trematodes belong to eight families of the order Digenea and include :

1. ***Pycnadena bariliusi*** Kumari, 1973 has been described from the stomach of ***Clarias batrachus*** (Linn.). It is characterised by long hind body, symmetrical testes, post-testicular extension of uterus and embryonated eggs with occulate miracidia and absence of postoral ring.

   It forms the first host and locality record.

2. ***Allocreadium handiai*** Pande, 1937 has been recorded from the intestine of four host species excluding ***Channa marulius*** (Ham.). It is characterised by the shape of the body, acetabulum smaller than oral sucker, tandem testes and small ovary attached to acetabulum.

   It is the first host and locality record from District Mathura (U.P.).

3. ***Orientocreadium batrachoides*** Tubangui, 1931 has been collected from the intestine of ***Clarias batrachus*** (Linn.).

   It is characterised by receptaculum seminis; pretesticular,

equatorial ovary and postequatorial testes. Vesicula seminalis externa is long and saccular.

This recorded form has been described from this region.

4. ***Orientocreadium indicum*** Pande, 1934 has been described from the intestine of all the five host species under the present project. It is characterised by the presence of spined cirrus and metraterm, spherical ovary, vitellaria extending from posterior margin of acetabulum to posterior end of body and the follicles of two sides meet without forming lattice.

It forms the first host and locality record.

5. ***Orientocreadium pseudobagri*** Yamaguti, 1934 has been recorded from the intestine of two host species viz - ***Clarias batrachus*** (Linn.) and ***Heteropneustes fossilis*** (Bl.). It is characterised by oval oral sucker, small prepharynx, long oesophagus and extension of vitellaria halfway between the caudal testis and posterior tip of the body and cirrus pouch on the right side of acetabulum instead of overlaping it.

It forms the first host and locality record.

6. ***Orientocreadium betwaensis*** n.sp. has been collected from the intestine of two host species viz ***Clarias batrachus*** (Linn.) and ***Heteropneustes fossilis*** (Bl.). This new species is

characterised by small body, transversely elongated ovary and testes, very small oesophagus and eggs rounded or oval.

It forms the first host and locality record.

7. ***Phyllodistomum tripathi*** Motwani and Srivastava, 1961 has been recorded from the intestine of ***Heteropneustes fossilis*** (Bl.). It is characterised by acetabulum distinctly larger than oral sucker, wavy margins having thick folds along with margins, flask shaped body, divisible into a narrow, tubular fore body and a foliate hind body. Prepharynx and pharynx absent, deeply lobed testes, cirrus sac absent, lobed ovary overlaps the right vitellaria. Rectpaculum seminis absent, vitellaria two lobed glands.

It forms the first host and locality record.

8. Metacercaria of ***Isoparorchis hypselobagri*** (Billet, 1898) Odhner, 1911 has been recorded from the body cavity of all the three host species of ***Channa*** (Bl.). It is characterised by body with thick cuticle, intestinal caeca long and serpentine. Acetabulum larger than oral sucker.

This recorded form has been described from this region.

9. ***Genarchopsis piscicola*** Srivastava, 1933 has been recorded from the intestine of ***Channa punctatus*** (Bl.). It is characterised by small and fusiform body. Oral sucker cuplike, acetabulum

large and well developed, prepharynx and oesophagus absent. Cirrus sac absent, uterine coils intercaecal, extending posteriorly upto the hind border of the testes.

This recorded form has been described from District Mathura (U.P.).

10. ***Genarchopsis goppo*** Srivastava, 1933 has been collected from the intestine of ***Channa punctatus*** (Bl.). It is characterised by elliptical shape of the body, acetabulum large and spherical. Cirrus sac absent. Vesicula seminalis well developed, vitellria two lobed glands.

It forms the first host and locality record.

11. ***Genarchopsis singularis*** Srivastava, 1933 has been described from the intestine of ***Channa punctatus*** (Bl.) and ***Channa striatus*** (Bl.). It is characterised by small oesophagus, symmetrical testes, cirrus sac absent and two compact vitellaria.

The parasite forms the first host and locality record.

12. Metacercariae of ***Euclinostomum heterostomum*** (Rudolphi, 1809) Travassos, 1928 has been collected from the body cavity of ***Channa punctatus*** (Bl.). It is characterised by presence of well developed pharynx and vitellaria, body large with collar like formation at anterior end. Intestinal caeca very thin upto

posterior border of acetabulum with lateral diverticulae. Vitelline follicles very small and immature.

This recorded form has been described from this region.

13. Metacercaria of ***Clinostomum complanatum*** (Rudolphi, 1819) Braun, 1899. A single record of this metacercaria is mentioned. This metacercaria was recovered in large numbers throughout the study period from July 1998 to June 1999 from the body cavity of ***Channa punctatus*** (Bl.).

14. ***Haplorchoides seenghali*** Dayal and Gupta, 1954 has been recorded from the intestine of ***H. fossilis*** (Bl.). It is characterised by small size of body, large size of testis, absence of cirrus pouch and acetabulum.

It forms the first host and locality record.

Part III deals with host-parasite relationship. An attempt has been made to correlate various ecological factors-biotic and abiotic, affecting host-parasite relationship. The data collected for a period of two years from July 1998 to June 2000 has been statistically analysed to study index of total helminth infection, host-wise analysis, overall incidence, level and intensity of parasitization, seasonal incidence, incidence of infection in relation to sex, co-relation between the size and sex of fish and intensity of infection in trematodes.

In the end of thesis, the references of the literature cited are given. Further, brief `Summary' of the work done and included in the thesis is also added in the end.

The present thesis extends over 175 pages and is illustrated with thirteen plates containing camera lucida diagrams of the trematode species described. Beside this one graph and five histograms are also given. All these figures are original and drawn by the author. The thesis includes two `Lists' and 20 Tables which presents the datas collected during the entire work.

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